Heating Piping & Air Conditioning

DESIGN
INSTALLATION
OPERATION
MAINTENANCE

JUNE ★ 1950

INDUSTRIAL
COMMERCIAL
INSTITUTIONAL AND
PUBLIC BUILDINGS

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Panel Heating, Cooling for Big Apartment....75

Using Baseboard Radiation in Tall Buildings.....98

How to Service Air Conditioning 88

Complete contents of this issue—page 3

ADJUSTABLE PIPE HANGERS AND SUPPORTS

for every piping requirement

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fig. 104
swivel ring
split ring type
¾" to 8" pipe

fig. 101
swivel ring
solid ring type
¾" to 8" pipe

fig. 101B
swivel ring
with boss
solid ring type
(optional)
2" to 8" pipe

fig. 150
swivel ring
solid ring type
¾" to 8" pipe

fig. 97
wrought ring
malleable nut
½" to 8" pipe

fig. 95
wrought ring
flattened end bolt
½" to 8" pipe

fig. 108
split ring
(ring only)
½" to 8" pipe

fig. 107
split ring
with socket
½" to 8" pipe

fig. 115
split ring
with turnbuckle
adjuster (optional)
½" to 6" pipe

fig. 138
extension ring
tapped I. P. S.
⅜" to 3" pipe

fig. 105
clip ring
¾" to 2" pipe

fig. 232
pear shape ring
½" to 6" pipe

steel clamps for high temperature process and power plant service

fig. 224
forged alloy clamp
4" to 16" pipe

fig. 212
wrought clamp
1½" to 24" pipe
(heavy duty, fig. 216
3" to 16" pipe)

fig. 295
wrought clamp
double-bolt
1½" to 24" pipe

fig. 261
riser clamp
¾" to 20" pipe

fig. 260
wrought clevis
¾" to 16" pipe

fig. 269
wrought band
¾" to 8" pipe

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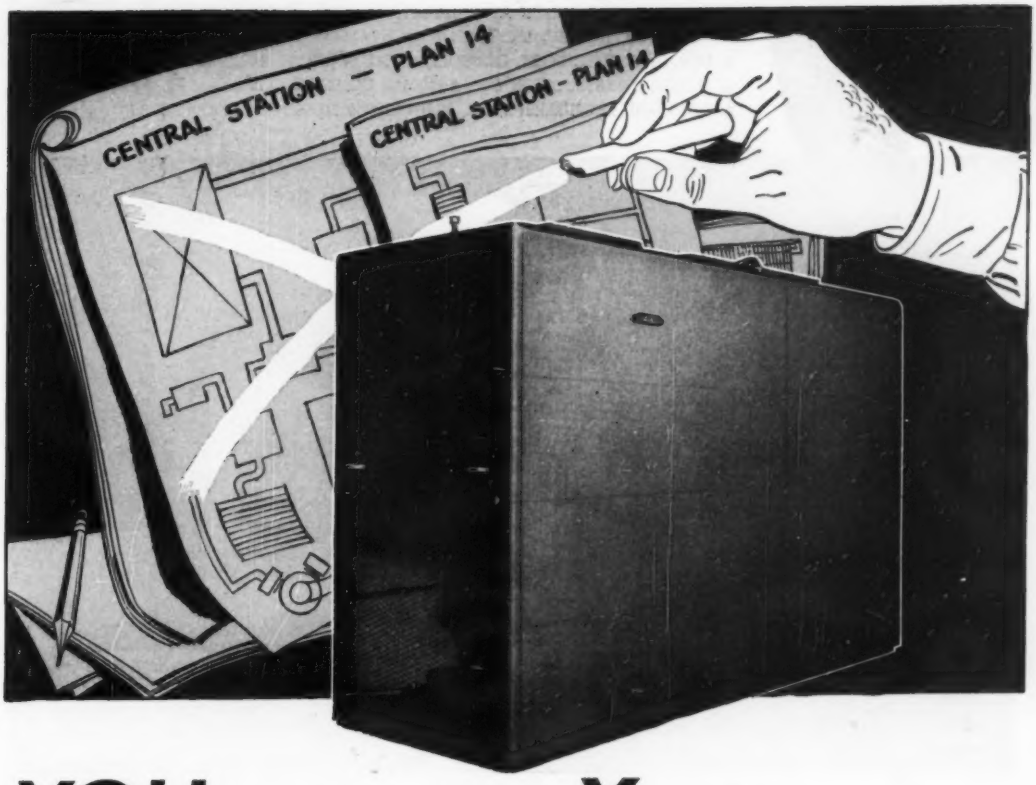

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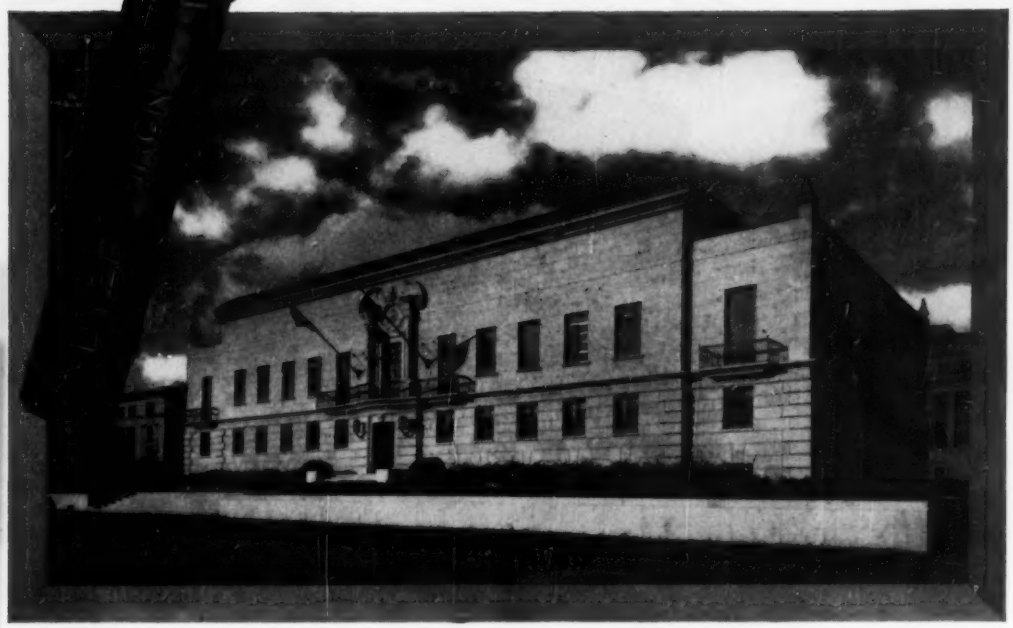

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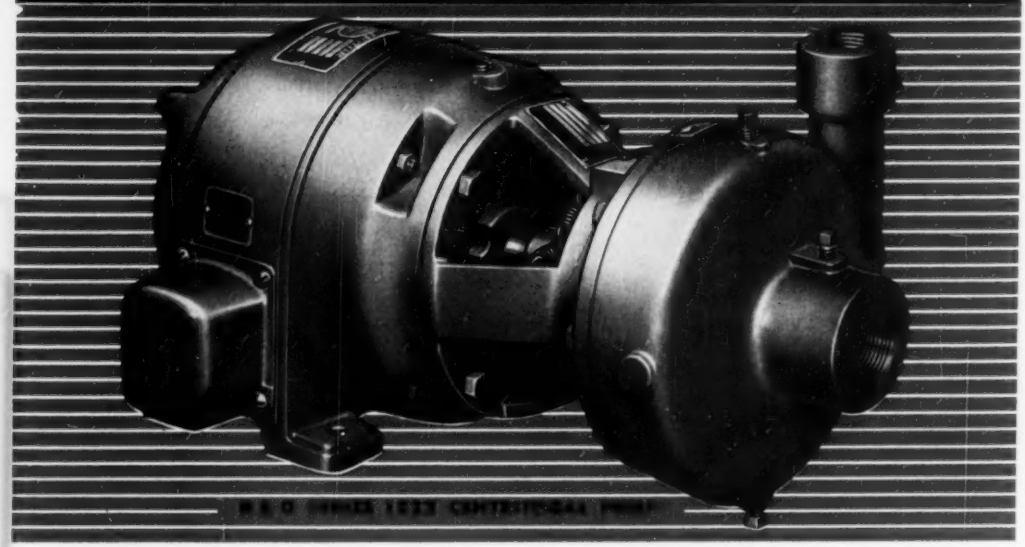

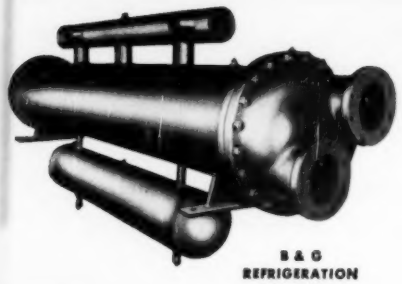

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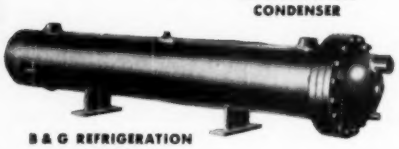

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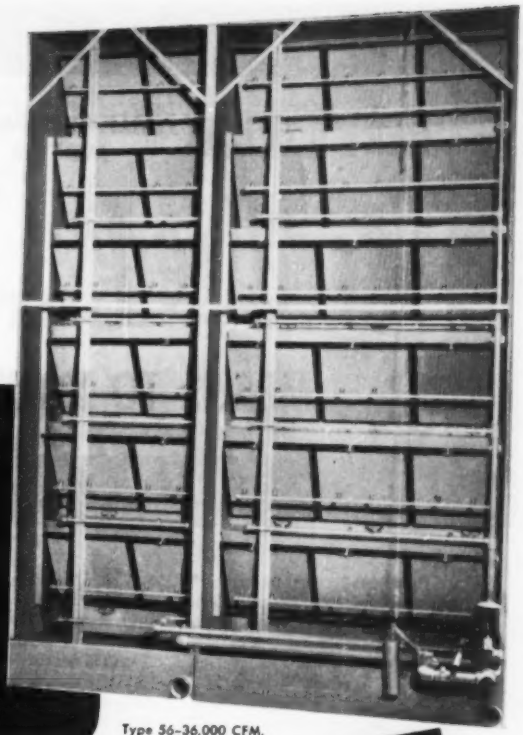

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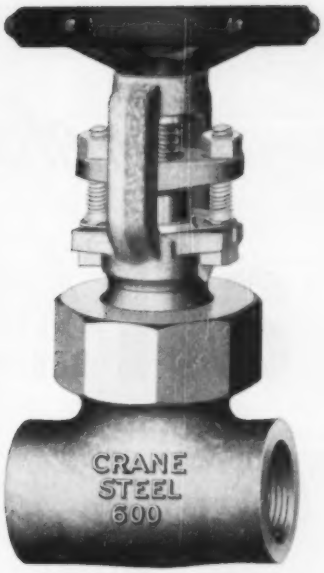

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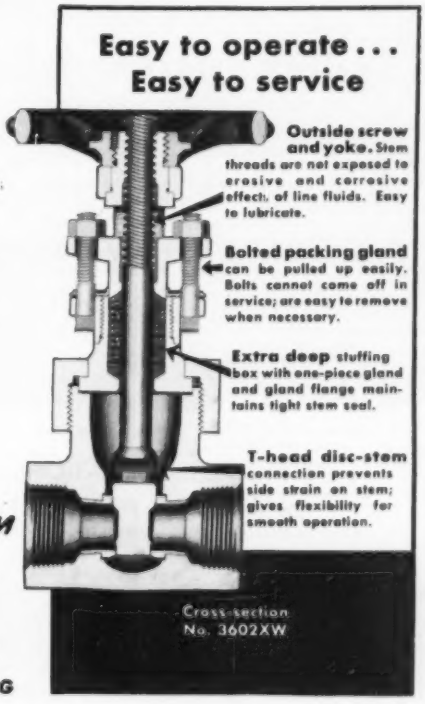
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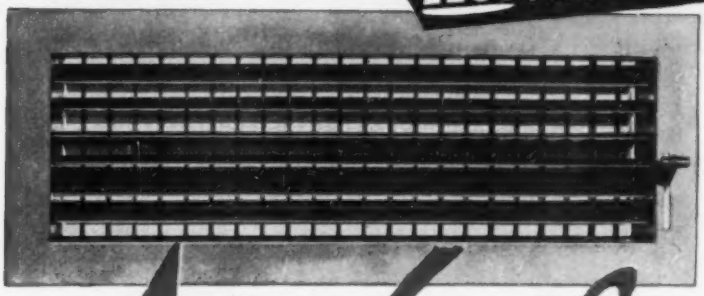

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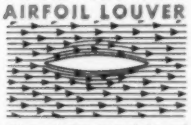
SOLID-SECTION AIRFOIL LOUVER



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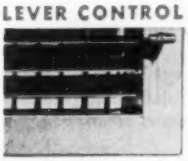
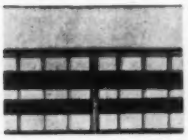


● Inconspicuous lever in face of frame controls dampers for complete shut-off.

EXTRA-STRENGTH FRAME . . . . .



● New, exclusive Titus concealed support eliminates unsightly mullions and butted construction.

The smartly designed #276 combines *4-way #270 grille* with the *multi-shutter damper* to assure maximum directional control with positive volume control and shut-off. Damper blades interlock for complete shut-off.

The two front sets of louvers are individually adjustable with blades on ¾ inch centers.

Dampers are controlled from face of grille by inconspicuous lever. Removable lever furnished at no extra cost.

EXTRA STRENGTH—LONGER LIFE

Sound, inspired know-how engineering gives the #276 superb simplicity of design with no unnecessary parts—no clumsy bulk. A special patented, *concealed support* eliminates unsightly mullions and butted construction permitting superior strength with no added weight.

EASY TO INSTALL

#276 grilles are light in weight—easy to carry—easy to fit—easy to put in place. *Save much costly time and labor.*

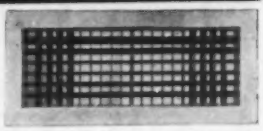
EXTRA VALUE AT LOWER COST

AIRFOIL grilles are priced down to give you more value—more performance—more efficiency—at less cost.

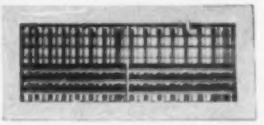
NOTE THESE OUTSTANDING AIRFOIL FEATURES . . .

- Smooth-as-glass AIRFOIL louvers.
- Extra-heavy frames.
- Airtight rubber gasket.
- Positive shut-off.
- Individual louver adjustment.
- Removable lever.

LOOK TO AIRFOIL FOR THE FINEST

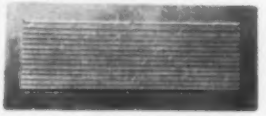


L-270 4-way directional grille for complete control of air stream.

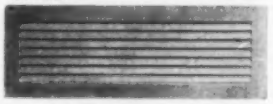


L-274 Double directional grille with multi-shutter damper.

S-8 4-way grille with louvers on ½" spaced front.



RL-21 Return air grille of fixed deflection type with closely spaced louvers.



RL-230 Return air grille incorporates rugged construction and smart design.

AG-25 Volume controller designed to fit behind grille.

CHECK TYPE OF GRILLE ON WHICH INFORMATION IS DESIRED

- ☐ Air conditioning outlets
- ☐ Perforated metal and ornamental grilles
- ☐ Return air grilles and registers
- ☐ Door ventilators
- ☐ Volume controllers
- ☐ Special made-to-order grilles

TITUS MANUFACTURING CORP., WATERLOO, IOWA

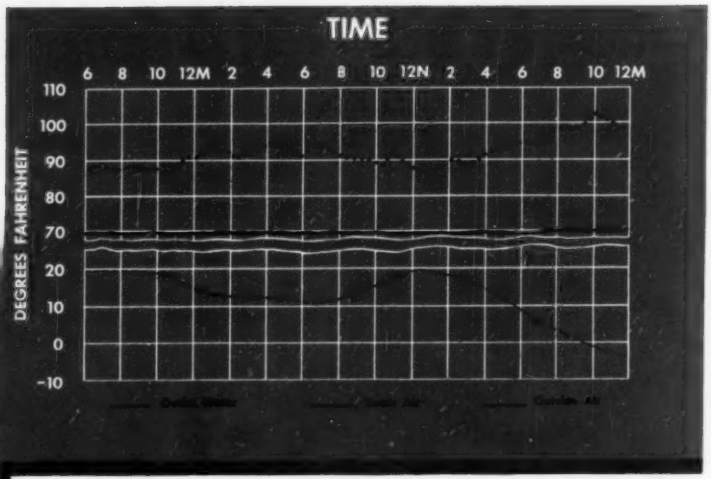
_____ Rush information on #276.
_____ Send complete catalog.
_____ Send literature on above checked items.

NAME _____

ADDRESS _____

CITY _____ STATE _____

If it's Panel Heating..... Use Electronic Moduflow Control



UNIVERSITY OF MINNESOTA TEST RESULTS

THE chart tells the story of Electronic Moduflow control for floor panel heating. See the results, recorded by independent scientific tests, in a typical domestic radiant floor panel installation. Room temperatures were held within a fraction of 70° in spite of extreme outside temperature variations.

Every sensing element in Electronic Moduflow responds instantly to the slightest temperature change—indoors or out. Gone is the time lag and sensitivity tolerance of mechanical controls. Overcome is the slow response—thermal inertia—that occurs when any radiant panel is embedded in concrete.

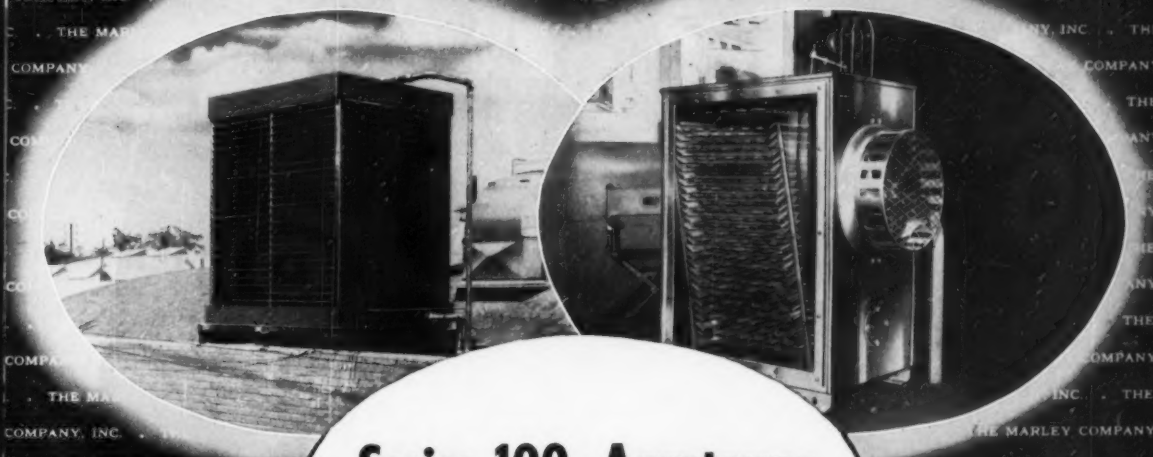
Electronic Moduflow is your assurance of accurate control. It means complete automatic comfort from every properly designed and installed radiant panel. Honeywell has prepared two booklets to answer your questions about Electronic Moduflow. These are entitled "Electronic Moduflow" and "Electronic Moduflow for Radiant Panel Heating." Arrange today to get your copies.

MINNEAPOLIS
Honeywell
FIRST IN CONTROLS

FREE

To get the booklets offered above, simply ask for numbers SA 1447 and 1499. Phone your local Honeywell office or address Minneapolis-Honeywell, Minneapolis 8, Minn.

77 BRANCHES FROM COAST TO COAST WITH SUBSIDIARY COMPANIES IN: TORONTO • LONDON • STOCKHOLM • AMSTERDAM • BRUSSELS • ZURICH • MEXICO CITY



Series 100 - Aquatower

"A One-Two Punch.."

...to solve any 3 to 50 ton water cooling problem

NO WATER cooling problem in the 3 to 50 ton range is too tough for this proven "Marley team." Either the mechanical-draft Aquatower or the natural-draft Series 100 will meet your specifications . . . no matter whether your problem is low first cost, low operating cost, unusual performance requirements or pumping problems. Nor is location a problem, as one of these two units can be placed anywhere . . . roof, basement, attic, outdoors, elevated grillage, or even suspended from the ceiling. These two towers, both ready for immediate shipment, make up a "one-two punch" that can whip any water cooling problem in this range.

The AQUATOWER (cutaway view shown), a packaged steel cooling tower, completely assembled, ready-to-go. Open pan water distribution basin which is especially desirable for serving multiple air conditioning units. Interior coated with rubber to resist corrosion. Deep pitch, slow speed, quiet fan. Packed from top-to-bottom with heart quality redwood filling. Grease-packed ball bearings. Weatherproof motor. Request Bulletin AQ-50 for dimensions and ratings.

The SERIES 100 . . . a natural draft, all heart quality redwood tower, completely prefabricated and piece-marked for quick field erection. All bolted construction. Balanced spray system with Marley patented nozzles. Basin complete with fixtures—sump and float valve. Request Bulletin 100-50 for dimensions and ratings.

And that's not all of the one-two punch . . . these towers may be purchased on a combined discount schedule on Marley's Merchandising Plan. Your nearest Marley Application Engineer will be glad to explain this plan and show you how the Aquatower and Series 100 will solve economically any water cooling problem.

MAIL THIS COUPON TODAY

The Marley Company, Inc., Kansas City 15, Kansas

Please send me without cost or other obligation:

- ☐ Aquatower Bulletin AQ-50
- ☐ Series 100 Bulletin 100-50
- ☐ Bring me up to date on Marley's new merchandising plan.

HP-6

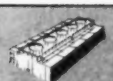
Name_____ Title_____

Company Name_____

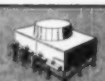
Address_____

City_____ Zone____ State_____

MARLEY


Double-Flow

Vairflo


DriCooler

Natural Draft

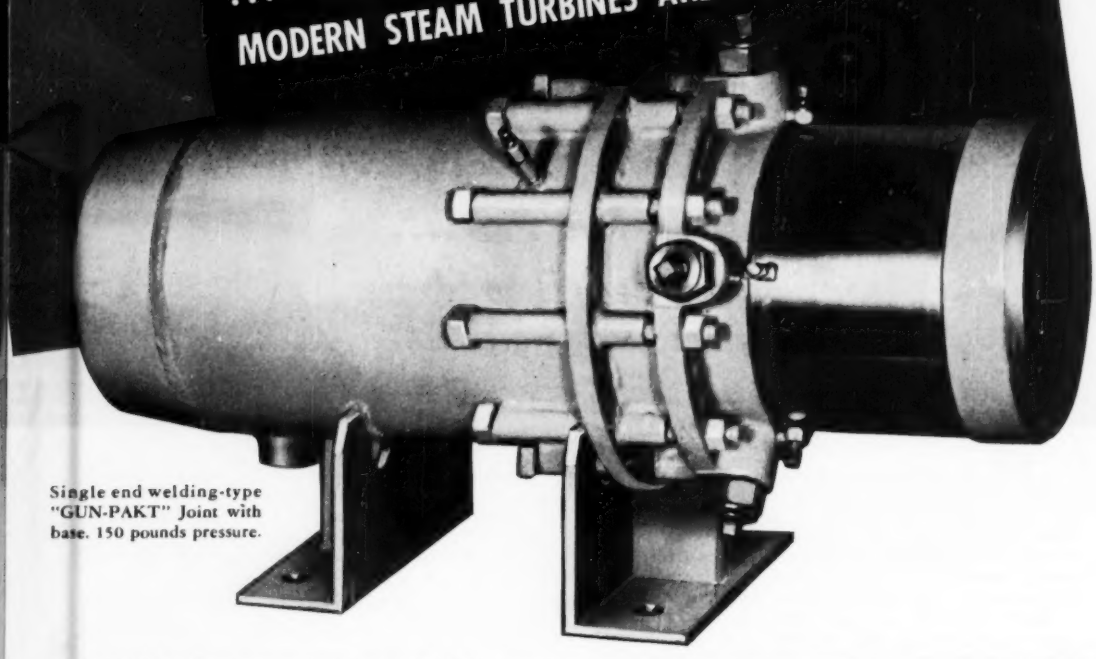
Counter-Flow

Aquatower

Spray Nozzles

GUN-PAKT EXPANSION JOINTS

...AS IMPORTANT TO STEAM DISTRIBUTION AS MODERN STEAM TURBINES ARE TO POWER PLANTS



Single end welding-type "GUN-PAKT" Joint with base. 150 pounds pressure.

The "GUN-PAKT" feature has been called the greatest expansion joint improvement of modern times.

It completely eliminates the need for costly shutdowns and heating interruptions while servicing the joints. "GUN-PAKT" Expansion Joints are repacked *under full steam pressure.* Insert a packing plug, twist a wrench, and the job is done. It's as simple as that. Special Alemite fittings provide for proper lubrication.

Maintenance costs are reduced too. One user spends 65 cents per year per joint. Another sets the figure at half that! Wherever steam is distributed, the "GUN-PAKT" Expansion Joint is the one they talk about—and specify!

FOR THE FULL "GUN-PAKT" STORY, GET YARWAY'S FREE BULLETIN EJ-1912. WRITE...

YARNALL-WARING COMPANY
107 Mermaid Avenue, Philadelphia 18, Pa.

Serviced

UNDER FULL STEAM PRESSURE

1. INSERT YARWAY PACKING
2. TWIST A WRENCH.

THE JOINT'S TIGHT . . . THE JOB DONE

YARWAY GUN-PAKT EXPANSION JOINT

ALCO

E EVAPORATOR

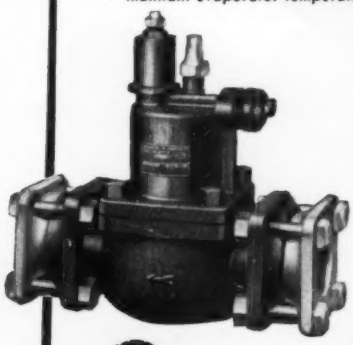
P PRESSURE

R REGULATORS

sensitive, simple-to-service—keep output and load in *better balance*

"On-off" thermostatic control alone just isn't enough in many of today's complex refrigeration systems. The answer: ALCO EPR suction line regulators to maintain constant evaporator pressure or provide a low temperature "limit". You can rely on them to:

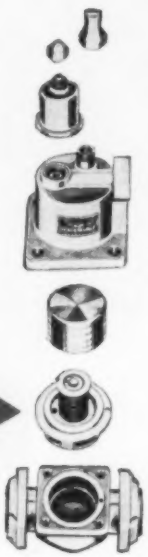
- utilize maximum capacity, prevent freezing in coolers
- control evaporators individually in a multi-temperature system
- maintain evaporator temperature at low loads to prevent dehumidification



simple, sturdy cage construction
sensitive pilot-operated action

PRECISION COLD CONTROL

This exploded view tells the story: minimum moving parts—lighter weight—less bulk—"come-apart" design for easier servicing without removing valve from line.



You're *sure* of better-balanced performance when you specify ALCO EPR Regulators!

25 ALCO

A QUARTER-CENTURY OF PIONEERING AND PROGRESS

ALCO VALVE CO.

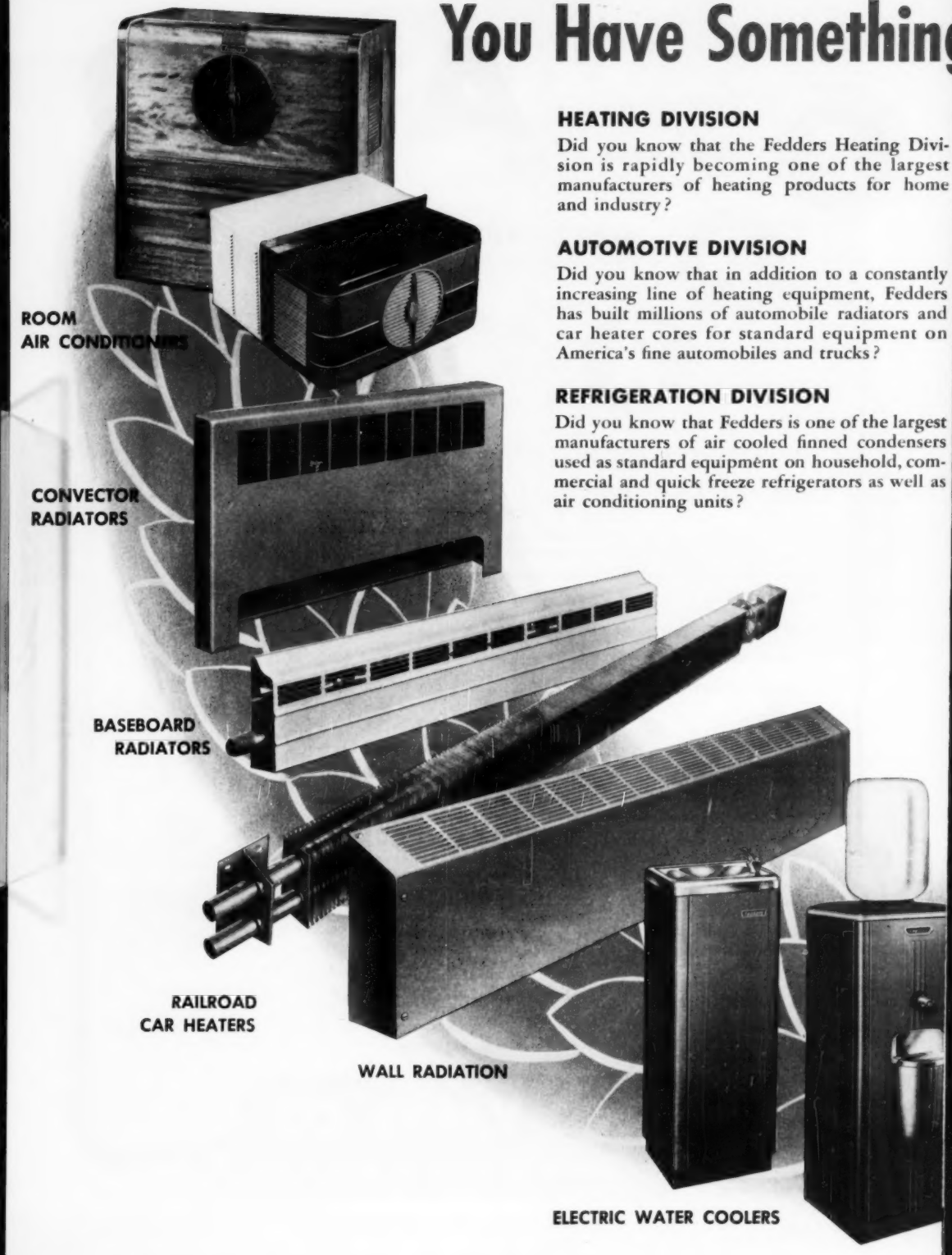
861 KINGSLAND AVE. • ST. LOUIS 5, MO.

Designers and Manufacturers of Thermostatic Expansion Valves; Pressure Regulating Valves; Solenoid Valves; Float Valves; Float Switches.

SEE YOUR ALCO WHOLESALER

4377

You Have Something



HEATING DIVISION

Did you know that the Fedders Heating Division is rapidly becoming one of the largest manufacturers of heating products for home and industry?

AUTOMOTIVE DIVISION

Did you know that in addition to a constantly increasing line of heating equipment, Fedders has built millions of automobile radiators and car heater cores for standard equipment on America's fine automobiles and trucks?

REFRIGERATION DIVISION

Did you know that Fedders is one of the largest manufacturers of air cooled finned condensers used as standard equipment on household, commercial and quick freeze refrigerators as well as air conditioning units?

EXTRA to Sell When You Sell FEDDERS Heat Transfer Experience

AIR CONDITIONING DIVISION

Did you know that Fedders is one of the foremost manufacturers of room air conditioning units?

This all adds up to an engineering background responsible for Fedders performance. Today, more than ever before, men who specify, sell, install and use heating equipment look to Fedders for the best.

For information on individual products, write

FEDDERS-QUIGAN
CORPORATION
BUFFALO 7, N.Y.

fedders

A Great Name Since 1896

YOU CAN BE **SURE**.. IF IT'S

Westinghouse

IN AIR HANDLING:

this lubrication nuisance is now out!

In offices and stores . . . in the thousand and one spots where fans, blowers and air-conditioning equipment are installed, motor lubrication is a costly nuisance. Think how much better a Life-Line motor fits these applications. Bearings are pre-lubricated. Grease cups . . . lubrication maintenance . . . dripping grease—all are gone. With Life-Line motors installed, you can mark motors off your greasing maintenance chart.

For the builder of air-handling equipment this means: Install Life-Line motors in inaccessible locations. Mount them vertically, horizontally, or any angle "in between". Grease is sealed in—can't drip. Correct lubrication is positive.

Pre-lubrication is but one feature of the Life-Line motor. Check its absolute smoothness and freedom from noise-producing vibration. Call your nearby Westinghouse representative for a copy of the Life-Line booklet, B-3842 or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Penna. J-21563

Westinghouse *Life-Line* Motors

INDUSTRY'S LEADING MOTOR

If you figure LIFE-COSTS . . . you'll figure LIFE-LINE

where RUST is ruin...

PATTERSON-KELLEY *Hot Water Storage Heaters for Delaware State Hospital, Farnhurst, Del., and St. Elizabeth's Hospital, Washington, D. C. Shells and heads of both heaters of Everdur plate, welded with Everdur Welding Rod by the inert-gas-shielded arc method. Dimensions of heaters sketched below are 42" x 72" and 48" x 120" respectively.*

Everdur is good insurance

EVERDUR* is a long-standing favorite for storage tanks in top-quality water heaters. Leading equipment manufacturers have had thorough experience in the fabricating of Everdur Alloys and are always ready to quote on Everdur for any water heater requirement. Cases in point are these hospital laundry heaters recently built by the Patterson-Kelley Co., Inc., East Stroudsburg, Pa.

Everdur Copper-Silicon Alloys can't rust. They're exceptionally strong, yet easy to work and easy to weld by usual methods.

For more information about Everdur Alloys, characteristics and applications, write The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

5065

*Reg. U. S. Pat. Off.

Where corrosion resistance counts — consider EVERDUR

ANACONDA®

COPPER-SILICON ALLOYS

NEW Electrifugal Pump

ENDS SOME MAINTENANCE JOBS, SIMPLIFIES OTHERS TO CUT PUMPING COSTS!

NO OTHER CLOSE-COUPLED PUMP can offer you *all* of these money-saving advantages you get from an *Electrifugal* pump:

1. New sealed motor bearings eliminate usual bearing maintenance costs. Cannot be over or under lubricated.
2. New unit-cast iron frame has no adapter between pump and motor; provides great rigidity and broad, stable base.
3. New improved double seal on front motor bearing keeps liquid out of bearing under all normal operating conditions.
4. New streamlined design has smooth, easy-to-clean exterior, better appearance.
5. Large opening in frame between pump and motor makes packing maintenance quick and easy.
6. Pump and motor are designed, assembled and tested as a unit in the same plant to work together and cut your cost.
7. Nation-wide application engineering and service help you select the right pump for your job and keep operating costs low.

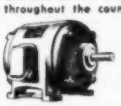
Other pumps in the Allis-Chalmers package pump line feature these same money-saving designs. Get all the facts from your Allis-Chalmers Authorized Dealer or Sales Office. Or write for Bulletin 52B6140.

A-3061

ALLIS-CHALMERS, 1171A SO. 70 ST. MILWAUKEE, WIS.

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.



MOTORS — ½ to 25,000 hp and up. All types.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE — Belts in all sizes and sections, standard and Vari-Pitch sheaves, speed changers.

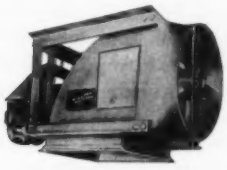
Electrifugal and *Texrope* are Allis-Chalmers trademarks.

ALLIS-CHALMERS

WING VENTILATING EQUIPMENT

WINGFOIL SAFETY VENTILATING FAN

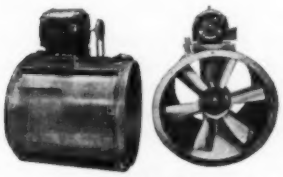
Distinguished for efficiency and rugged construction. The new Wingfoil fan wheel moves maximum volumes of air with minimum horsepower, due largely to its non-overloading feature. Sizes from 10" to 60" dia., with free air capacities from 825 to 59,000 CFM. Larger sizes on special order. Either direct or belt drive. Heavy steel guards provide safety.



WINGFOIL DUCT FAN

(Elbow Type)

Designed to form an elbow in the duct system, the elbow-shaped housing in a strong rectangular frame permits installation with the inlet in any desired position. Motor and drive are outside the air stream, therefore remain cool, clean, and easily accessible. The new Wingfoil Fan has a remarkable "non-overloading" characteristic. Sizes 10" to 60"; capacities up to 85,000 CFM.

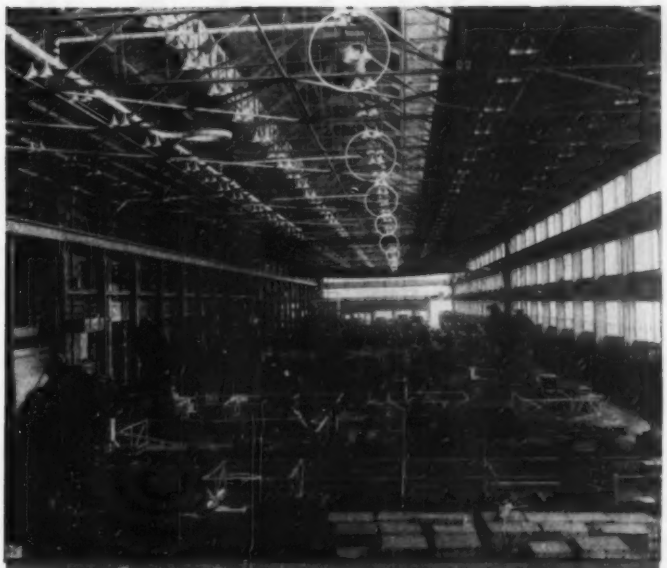


WINGFOIL DUCT FAN

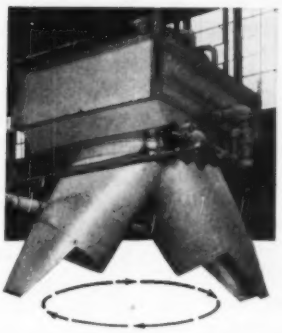
(Straight Line Type)

Designed to form a part of any straight run of duct. The motor is mounted on an adjustable base outside of the housing. V-belt drive is through an air tube carried across the housing and supporting fan shaft and bearings. Fan wheel is the new non-overloading Wingfoil Fan. Bearings are grease-sealed, requiring minimum of attention.

WRITE FOR BULLETINS



Perfection Stove Sought Perfection in Factory Heating



In Perfection Stove Company's new Ivanhoe plant at Cleveland, O. the problem of heating the press building (shown above) was solved by the installation of 9 WING Revolving Unit Heaters. This building is 855 ft. long by 112 ft. wide with the peak of the truss roof 66 ft. from floor. Lowest edge of the heaters is 44 ft. above floor level. The heat output is evenly distributed by the discharge outlets which revolve slowly and continuously. "We wanted equalized no-draft heating," says C. J. Kessler, Perfection Stove's Production Engineer, "and we got it."

Write for a copy of WING Bulletin HR-5

L. J. Wing Mfg. Co.

140 VREELAND MILLS ROAD
LINDEN, N. J.

Canadian factory: Montreal

Wing

Revolving UNIT HEATERS

Air Conditioning in Textile Mills*...

by **P. L. Davidson, Philadelphia, Pa.**
and **John deB. Shepard, Greenville, S. C.**
Consulting Engineers

Philip L. Davidson

John deB. Shepard

Question: Is a Central Station System more desirable than a Unit System?

Answer: "Both have obvious advantages. In a central station versus units, the cost of the base mechanical system is approximately equal. The former's cost exceeds that of the unit because it requires enclosure. This added cost, however, is offset by inherent easier maintenance and improved operating efficiency. Units, generally, should be limited to a capacity of 12,000 cfm. Central stations are often not practical beyond one floor of multistory mills, or to exceed 150,000 cfm."

Question: Does refrigeration have a place in textile mills?

Answer: "Definitely. Recent refrigeration installations give quick opportunity to spot effects of constant temperature in improved machine operation and handling of fibres. Current experiences with central systems reveal: (1) In a weave room operating on rayon fabrics with a modern central station humidifying system, the loom stops ranged from 2.3 to 5.4 per producing loom hour. The loom efficiencies averaged 92.6%, the seconds ranged between 15 and 16%. *When refrigeration was added,* the loom stops over a period of two months dropped to a range of 1.2 to 2.9. The efficiencies rose to 96%; the seconds dropped to a range between 4 and 7%.

(2) "A cotton spinning mill, after the installation of refrigeration, increased its spindle speeds 5% and its work load 14% with no increase in ends down.

(3) "A weave room running on combed broadcloth showed, after installation of refrigeration, an increase in production of 4½ to 5%.

(4) "A New England mill reported a 25% increase in production in a spinning room after the installation of a central station air conditioning system with refrigeration. This was attributed primarily to a decrease in absenteeism and only secondarily to a decrease in ends down.

"Records such as these highlight the results obtained with central station equipment where refrigeration is employed to fix temperatures constantly within a range of maximum efficiency and reasonable employee comfort. Advantages are frequently realized at an investment no greater than that required with straight or 100 per cent air systems.

"*This experience, proven in the textile field, should be significant in setting the pattern for all industrial air conditioning.*"

• • •

YORK SALES POLICY

York believes in channeling contract work through Architects, Engineers and Contractors. You are therefore assured of unequaled support toward providing the finest air conditioning systems for your clients. York Corporation, York, Penna.

York's complete line of refrigerating and air conditioning products is the result of 65 years of resultful research and encompass:

1. a complete line of equipment
2. competitive prices
3. accurate, dependable product ratings
4. technical assistance based on "case histories"
5. cooperation with architects, engineers and contractors
6. practical help from York-trained engineers
7. a national organization
8. continuous product research and development
9. certified maintenance

York refrigeration air conditioning

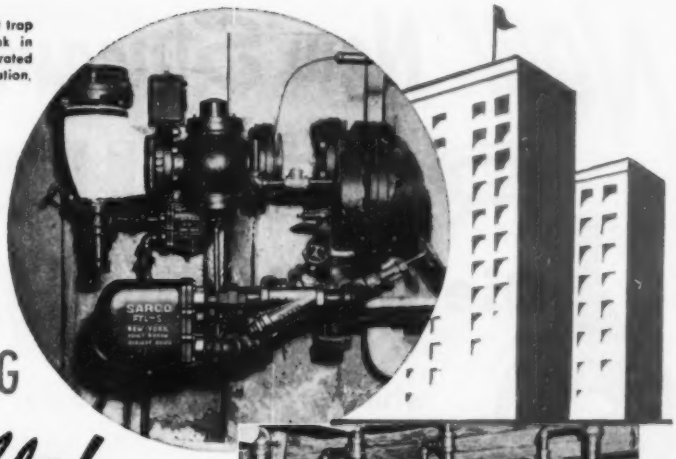
The big advances come from

YORK

Headquarters for – **Refrigeration and Air Conditioning**

This advertisement condensed from an article authored by these consulting engineers, and published in* **Refrigerating Engineering, *February, 1950*

Sarco TR-21 control and Float trap on 1300 gallon storage tank in the Equitable Building, operated by The Real Estate Corporation, Chicago.



HOW SARCO KEEPS A BIG OFFICE BUILDING *Comfortable!*

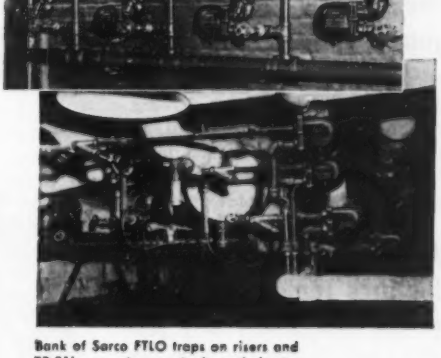
Few office workers realize what goes on below the street level in order that they may work in comfort and without interruption.

But the engineer can tell you that Sarco is the heart of the heating and air conditioning systems in this big building. In fact, he says he "wouldn't have anything else."

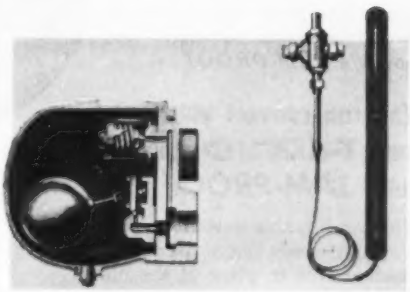
Hot water service, the source of many tenant complaints, is controlled to a degree with Sarco TR-21 regulators, float traps and strainers on primary and secondary tanks—including one for air conditioning. (See illustrations)

A bank of risers is dripped by Sarco float traps and of course Sarco radiator traps are found on every radiator.

Engineered primarily for service, such a system also results in minimum fuel consumption.



Bank of Sarco FTLO traps on risers and TR-21's on storage tank and heater



YOU CAN HAVE THIS SERVICE TOO . . .

It sounds simple, and yet hundreds of buildings are still handicapped by impossible heating hookups; noisy radiators, some areas too hot, others too cold, hot water complaints all day long, and a fuel bill that is 10 to 20% higher than it should be.

The Sarco Representative near you will look over your building without obligation. You will be surprised to see how much can be done and how little it will cost.

271

SARCO SAVES STEAM

SARCO COMPANY, INC.

Represented in Principal Cities

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SARCO CANADA, LTD., TORONTO 5, ONTARIO

IMPROVES PRODUCT QUALITY AND OUTPUT

NOW New Streamlined RIDGID 65R

Die Stock that WON'T JAM

while threading with power drive or by hand

The Threader Improvement you've wanted for years!

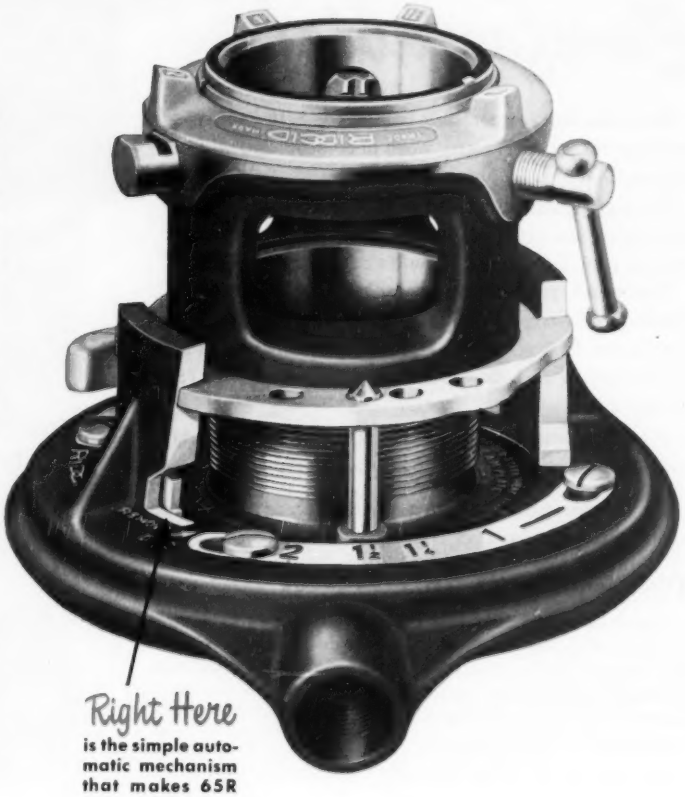
New *JAM-PROOF* drive plate automatically kicks out driving ratchet pawl when standard length thread is cut.... You don't have to watch it — lead screw can't jam on workholder.

All other RIDGID 65R features remain the same

Perfect threads on 1" to 2" pipe with 1 set of high-speed steel dies — sets to pipe size in 10 seconds — mistake-proof self-centering workholder sets instantly — and now it's *JAM-PROOF.*

You can convert your present RIDGID 65R to new *JAM-PROOF* type

You can buy this new drive plate . . . and easily put it into your present 65R in place of the old drive plate.



Buy the new streamlined JAM-PROOF 65R or drive plate at your Supply House

RIDGID

WORK-SAVER PIPE TOOLS • THE RIDGE TOOL CO. • ELYRIA, OHIO

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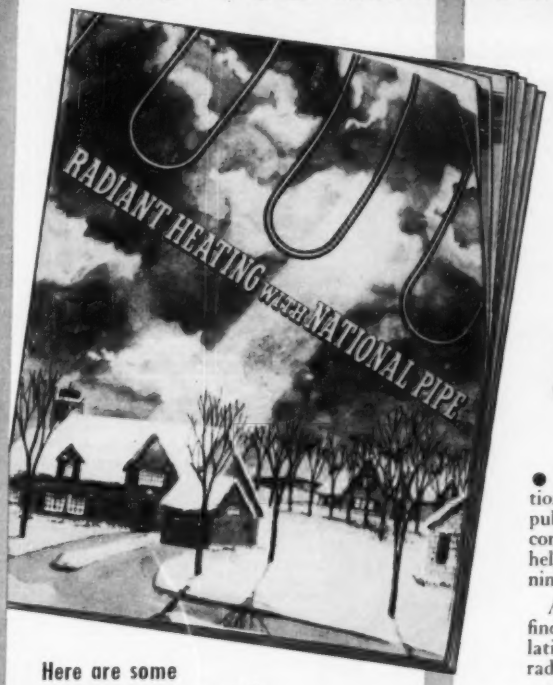

It tells what you want to know about

Radiant Heating

● This 48-page book, "Radiant Heating with National Pipe" is one of the most authoritative books published on the subject. It brings you a complete, comprehensive story of radiant heating and gives helpful information as a practical basis for the planning and installing of an efficient system.

Architects, heating engineers and contractors will find the book valuable for use in planning new installations. It answers many important questions about radiant heating. For example —

What is the approximate cost of a radiant heating system?

Would it cost more or less to operate a radiant heating system than other types, and by how much?

What effect do rugs and rug pads have on heat transfer in a radiant heating system?

These and many other questions are competently answered. This book also shows you how to calculate pipe sizes for various conditions. Mail the coupon and a copy will be sent at once.

Here are some of the subjects covered:

What is radiant heating?
How radiant heating is designed for comfort.
How to estimate heat losses.
How to determine radiant heating coil requirements.
Radiant heating comfort chart.
What heating engineers claim for radiant heating.
Methods of floor and ceiling installation.
Typical pipe coil patterns.
Questions and answers on radiant heating.
Heat transmission tables.

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Please send me a copy of your FREE book, "Radiant Heating with National Pipe."

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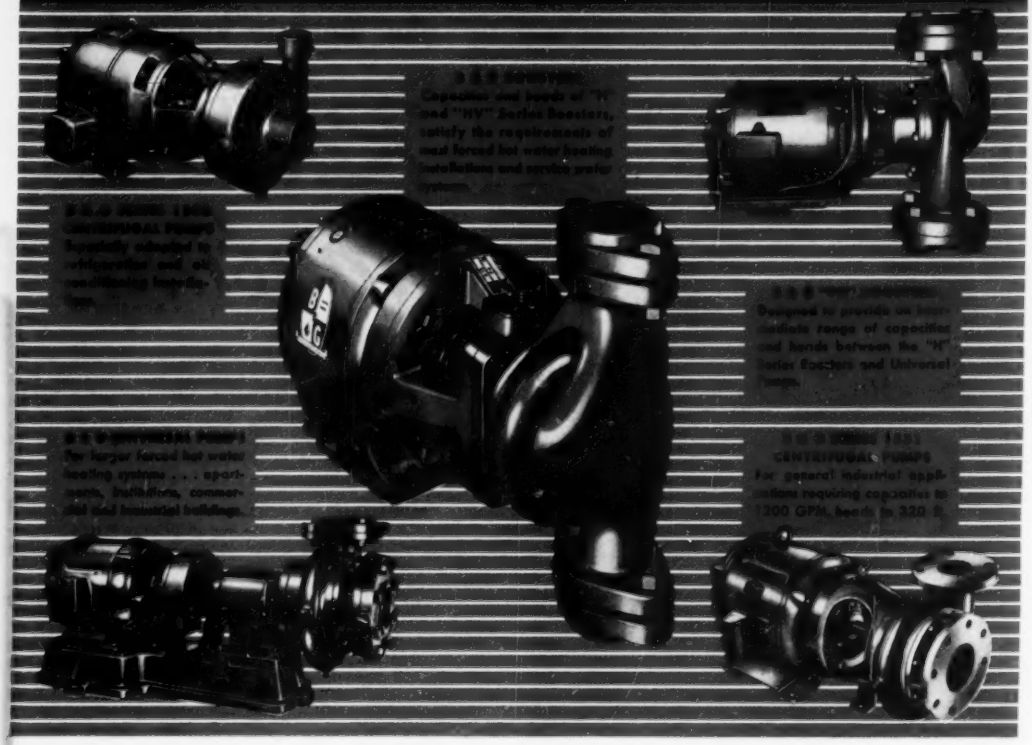
B&G Hydro-Flo PUMPS

FOR FORCED HOT WATER HEATING SYSTEMS . . . SERVICE WATER SYSTEMS . . . REFRIGERATION AND INDUSTRIAL APPLICATIONS



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The excellence of design and construction which has made the B & G Booster the largest selling pump in its field is now expanded over a comprehensive line of centrifugal pumps.

For any size of forced hot water heating system, B & G Types "H", "PD" or Universal Pumps enable you to make a selection of head and capacity best suited to the job. Service water heating systems likewise can be most economically circulated with these pumps.

For refrigeration, air conditioning and general industrial application, B & G Series 1522 and 1531 Centrifugal Pumps are satisfying the most critical engineers and operating men. "B & G" is the symbol of quality—and your warranty of satisfaction.

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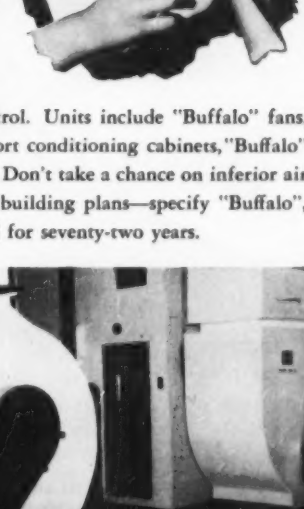
*Reg. U. S. Pat. Off.

One of the many new exchanges with "Buffalo" air equipment and pumps.

AIR BY "Buffalo"

PLAYS A PART IN EXPANDED TELEPHONE SERVICE!



● Better service to more people is the result of a vast expansion program of the Telephone Companies. New buildings and new equipment bring service to many more subscribers—speed up long distance service —make available radio-telephone service.

Many of these new buildings, housing intricate equipment and highly trained personnel, have the finest indoor climate control. Units include "Buffalo" fans, dehumidifiers, comfort conditioning cabinets, "Buffalo" pumps and heaters. Don't take a chance on inferior air equipment in *your* building plans—specify "Buffalo", a leader in the field for seventy-two years.

"Buffalo" Belted Vent Sets Used to Exhaust From Dial Exchange.

"Buffalo" Type "LL" Fans—Air Supply Units insulated to handle refrigerated air.

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VENTILATING FORCED DRAFT | AIR WASHING COOLING | AIR TEMPERING HEATING | INDUCED DRAFT EXHAUSTING PRESSURE BLOWING

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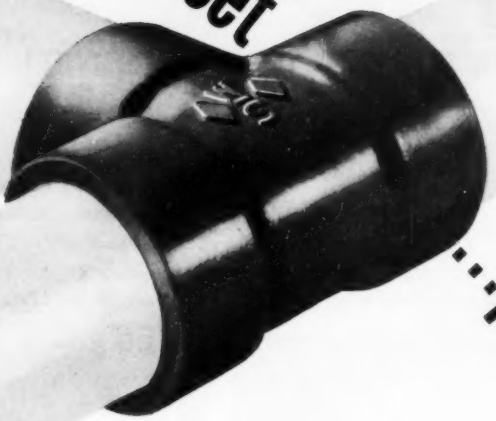
Wherever pipes meet ...permanently



IN THE REFRIGERATION FIELD,

the surest and safest way to prevent fittings leaks is to install W-S Double-diamond Screw End and Socket Weld Forged Steel Fittings.

Designs are carefully engineered. Basic Materials are selected from a wide choice of carbon, stainless and alloy steels. Drop forging and precision machining makes them light in weight, assures accuracy of finish, and, all are instrument inspected for perfection of threads, sockets, angles and concentricity. Investigate them today.

Write for Bulletin A3-50. For information on stainless and alloy steel fittings ask for Bulletin S-1.

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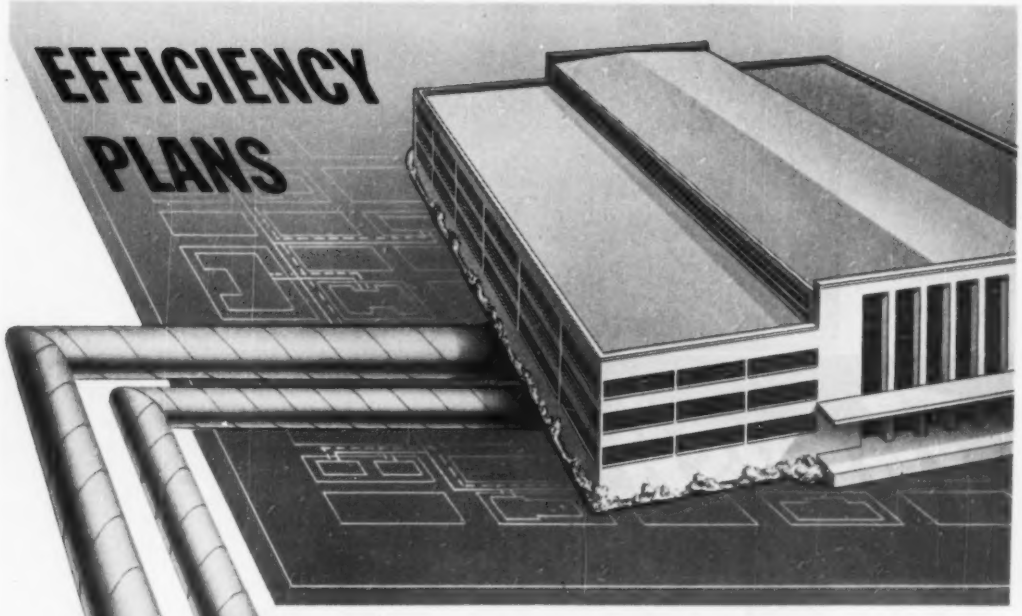

Start with Ric-wiL Insulated Piping

● Ric-wiL Prefabricated Insulated Piping occupies a key position in the planning and production of efficient insulated piping in central heating or air conditioning systems for multiple building projects.

Experienced architects, engineers and contractors recognize Ric-wiL systems as the practical answer for exposed or underground insulated piping. They are custom engineered and prefabricated of the finest materials for quick economical installation, efficient performance, and long maintenance-free life.

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Call the Ric-wiL office nearest you and our representative will be glad to give you detailed technical information as related to your specific problem.

For full technical information on Ric-wiL Insulated Piping Systems, call or write the Ric-wiL office nearest you or Dept. 1-N in Cleveland, Ohio.

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FOR FORTY YEARS THE GREATEST NAME IN INSULATED PIPING SYSTEMS

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Leading name in RADIANT HEAT

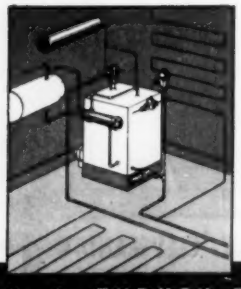
LOW COST HOT WATER CONTROLS

THRUSH Radiant Hot Water Heat is a leader . . . in economy, in efficiency, in popularity. Thrush Flow Control System offers the simplest yet most satisfactory method of automatically controlling temperature of radiant ceiling, wall or floor panels. This system provides uniform heating comfort without continuous Circulator operation. Inexpensive No. 201 Thrush Radiant Heat Control, illustrated below, maintains a constant room temperature and system water temperature without variation. Thrush Forced Circulating Flow Control System is easy to install. It provides economical heating plus summer as well as winter supply of domestic hot water for laundry, bath and kitchen use.

FLOW CONTROL VALVE WITH AIR TUBE

WATER CIRCULATOR

NO. 201 RADIANT HEAT CONTROL

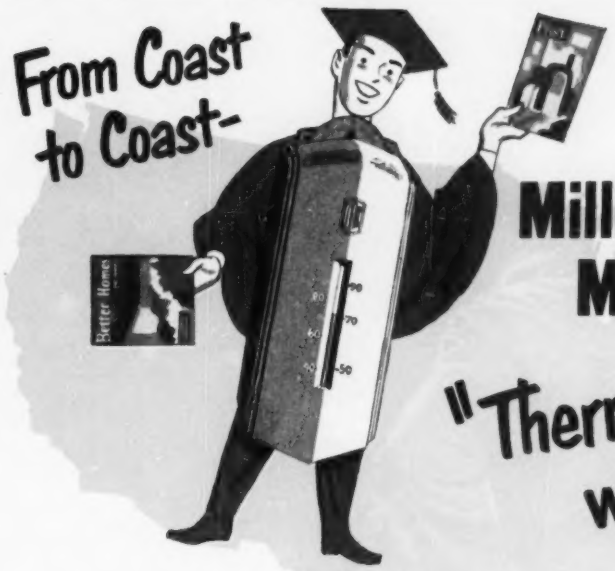


THRUSH FLOW CONTROL SYSTEM OF HOT WATER HEAT

Send for booklet giving the complete story of Thrush Radiant Hot Water Heat. The same simple equipment may be used for zoning apartments inexpensively and is ideal for modernizing home heating plants. Ask your wholesaler about it or write Dept. E-6.

H. A. THRUSH & COMPANY · PERU, INDIANA

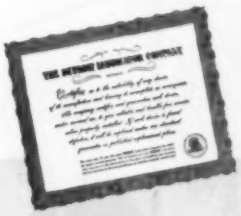
demand DETROIT CERTIFIED CONTROLS



Millions Have Now Met Detroit's "Thermostat with a Brain"!

INTRODUCING GREAT NEW PROFIT POSSIBILITIES FOR YOU!

Now is the time for you to take advantage of this great sales opportunity! National advertising by DETROIT has made millions of home owners and home builders the country over, *Timed Cycling* conscious! By selling the full line of DETROIT controls with the remarkable *Timed Cycling* Room Thermostat, you can give your customers the assurance of fuel economy and perfect heat control by the elimination of over and under heating! Moreover, DETROIT controls are the *only* ones certified for reliability, performance, and engineering excellence! So order your supply today—they will bring greater comfort to your customers and greater profits to you!



Look for this Certificate — only Authorized DETROIT *Wholesalers sell certified Controls.*

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Division of American Radiator & Standard Sanitary Corporation
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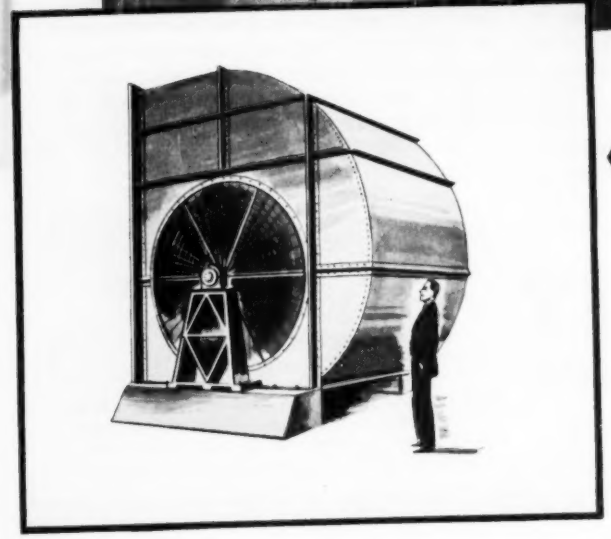
Serving home and industry. AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

We'll



One of the Sturtevant Fans
that ventilate the
Brooklyn-Battery Tunnel.

need air-

25,000 TONS EVERY HOUR

Putting *Air* to work . . .

666,000,000 cubic feet of air per hour: that's what the engineers required to ventilate New York's new Brooklyn-Battery Tunnel. And to handle this huge job, they used 53 Westinghouse Sturtevant Fans and Blowers.

You will find Sturtevant-engineered ventilation in tunnels from coast to coast. Oakland-Alameda, Detroit-Windsor, New York's Holland and Queens-Midtown Tunnels, and 7 tunnels on the Pennsylvania Turnpike . . . all are examples of the value that consulting engineers place on the efficiency and dependability of Sturtevant air handling equipment.

You, too, can look to Westinghouse for any air moving, air cleaning or air conditioning equipment. In its broad line, you will find the type best suited to your particular job and the capacity you need—a product of advanced engineering and design. Westinghouse's Sturtevant Division makes more products to put air to work in more different ways than any other manufacturer. For information, write to Westinghouse Electric Corp., Sturtevant Division, Hyde Park, Boston 36, Massachusetts.

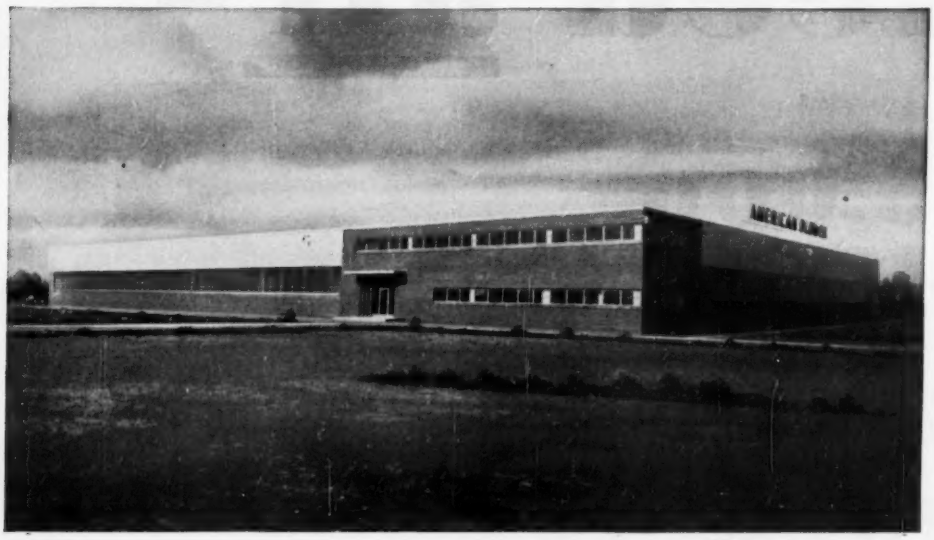
Westinghouse Sturtevant Fans and Blowers find wide use in Tunnel Ventilation, Power Plants and all types of Industrial Plants.

YOU CAN BE SURE...IF IT'S

Westinghouse

J-80184

American Blower—a time-honored name in air handling



Newest American Blower plant, located in San Leandro, California

OPEN for BUSINESS!

American Blower's New West Coast Plant

To better serve our customers on the Pacific Coast and western section of the United States, American Blower has just completed its modern, new plant, strategically located in San Leandro, California.

American Blower is universally recognized as one of the foremost manufacturers of air handling and conditioning equipment for heating, cooling, drying, ventilating, dust collecting and air conditioning for industrial and commercial applications . . . as well as kitchen and attic fans for homes and Gyrol Fluid Drives for smooth power transmission in industry.

For complete product data contact your nearest American Blower Branch Office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

Unit Heaters

Ventura Fans

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Gyrol Fluid Drives

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Air Conditioning Equipment

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YOUR BEST BUY **AMERICAN BLOWER** AIR HANDLING EQUIPMENT

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

American Blower—a time-honored name in air handling

In Cleveland, as in other cities, American Blower Air Handling Products serve commerce, industry and public utilities. For air handling data in the Cleveland area, call American Blower—Main 6846. In other areas, consult your phone book.

It pays to look before you buy. Air handling equipment differs widely in quality, design, quietness, operating costs and efficiency. Comparative tests by many buyers have thoroughly proved the superiority of American Blower Air Handling Equipment.

Air is free . . . use it profitably!

You've read how it will pay you to investigate the advantages of putting air to profitable use in previous American Blower advertisements.

Now, here are actual examples of what some companies are doing about it—

A large automotive manufacturer recently added *115* new American Blower Ventilating Fans in just *one* plant.

A midwest power company purchased *40* American Blower Heavy Duty Coils as air heaters for boilers.

A large life insurance company installed 260 American Blower Utility Sets to ventilate a new apartment building on the West Coast.

These buyers know that it pays to use air profitably. They insist on the highest-quality equipment. Many of them have run tests on several makes of equipment before buying American Blower products.

If you would like to know more about these fine products, how they can be applied profitably to your business, or how you, as a contractor, can profitably apply them, phone our nearest branch office.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

YOUR BEST BUY

AMERICAN BLOWER

AIR HANDLING EQUIPMENT

Serving home and industry

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS • DETROIT LUBRICATOR • KEWANEE BOILERS • ROSS HEATER • TONAWANDA IRON

Meet the new

LEWIN-MATHES HANDIGRIP CARTON*

HANDLE WITH CARE
LEWIN MATHES
...the sturdiest, handiest carton ever built for individual copper tube coils
INDIVIDUALLY PACKED FOR RESHIPMENT

- FROM MILL TO JOB—rigid *Handigrip* Cartons protect and support coil from 12 points!
- HANDIER TO STOCK—stacks compactly or hangs up!
- HANDIER TO PICK UP—and carry!
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LEWIN-MATHES COPPER TUBING . . . . . the only tubing protected in eight-sided cartons

*PATENT APPLIED FOR

LEWIN MATHES

LEWIN-MATHES COMPANY · · SAINT LOUIS, MISSOURI

Modine Presents
A Great New Cabinet Unit for
HEATING and COOLING

HIGH CAPACITY HOT WATER HEATING—new specially designed water coil permits 2 lbs. steam performance on 180° water.

YEAR 'ROUND COMFORT — a single unit for forced hot water heating . . . chilled water cooling. Steam models for heating only.

GOOD LOOKING — smartly styled and finished in beige-gray enamel. Louvered base in darker color. Parker-Bonderized for lasting beauty.

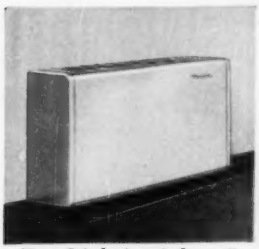
FRESH AIR VENTILATION—available with non-freeze steam coil and built-in mixing damper for ventilating applications.

EASY ACCESSIBILITY—entire front panel removable for complete accessibility to motor, blowers, coil and piping.

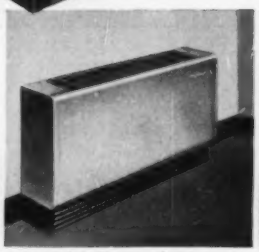
QUIET OPERATION — hushed performance . . . skillful silencing of mechanical and air-rush noises.

Type C unit with optional plenum base for floor mounting illustrated.

Design and Mechanical Patents Pending

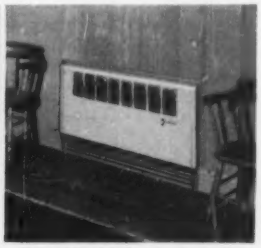


Type C is basic unit for wall mounting. Accessory equipment adapts it to other installations.



Attractive louvered plenum base (optional) attached on job, makes Type C a floor-mounted cabinet.

Optional inlet grille converts Type C to a ceiling cabinet. Duct connectors can also be furnished.



Type CR with face outlet grille and plenum base available at a slightly higher price for recessed installation.

QUICK, positive distribution of heated or cooled air is yours with the new Modine Cabinet Unit. Quiet efficiency, attractive appearance and quick response to automatic controls make it ideal for stores, showrooms, schools, lobbies . . . all modern commercial and public buildings. Available in 5 capacities from 120 to 640 Edr.

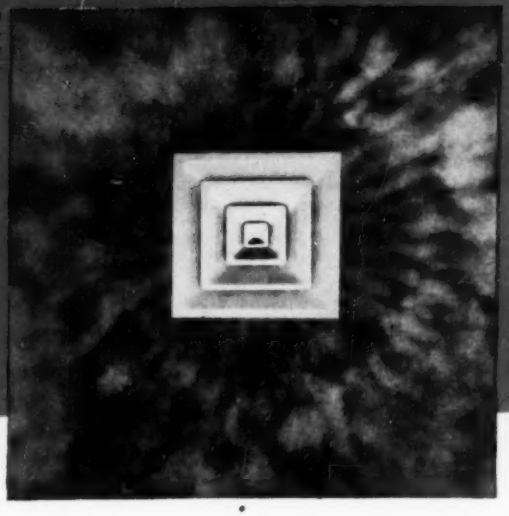
WRITE FOR NEW BULLETIN 550 TODAY! You'll find your Modine representative listed in the classified section of your phone book. Or write direct. Modine Mfg. Co., 1509 Dekoven Avenue, Racine, Wisconsin.

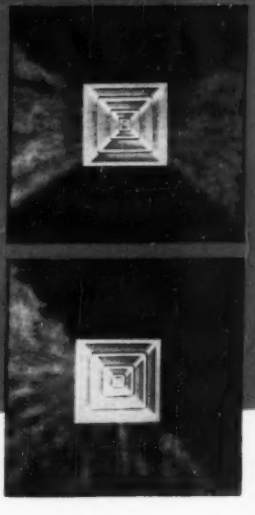
Modine
CABINET UNITS
FOR HEATING & COOLING

U-1063

360° AIR DISTRIBUTION *or any required pattern*

Photographs of actual smoke tests showing various air patterns obtainable with the Type D Diffuser.





Aerofuse TYPE D
SQUARE DIFFUSER

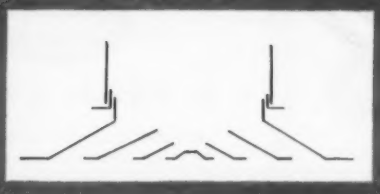
An important addition to the extensive Aerofuse line, the new Type D, is an efficient, smartly styled diffuser developed to answer the increasing demands from engineers and architects for a square outlet that will deliver supply air in a 360° pattern . . . and, in appearance, harmonize with modern building interiors.

Engineered to the highest standards of operating performance, the Type D Aerofuse provides complete flexibility of air pattern. To meet specific job requirements where circular distribution is not practical, baffles may be used to blank-off portions of the diffuser and direct air stream in a variety of patterns. Thus the Type D can be installed near walls, supporting columns and other obstructions without creating drafty conditions.

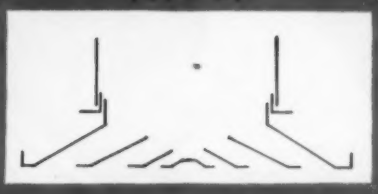
at the vital point of air delivery

Two types are available . . . Type DF, for flush mounting in standard acoustical tile ceilings . . . Type DE, for installation on plaster ceilings. Both types are listed in four sizes (12" x 12", 16" x 16", 20" x 20", 24" x 24", 30" x 30") with neck diameters from 6" to 15"

TYPE DE



TYPE DF



For complete details, size selection information, and engineering data, write for a copy of Bulletin 551

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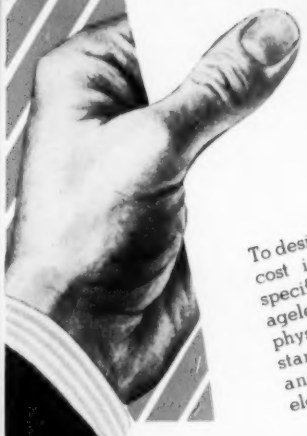
NEW BRITAIN, CONNECTICUT

FOR GREATEST CORROSION RESISTANCE
EASY FABRICATION
ELECTRICAL CONDUCTIVITY
THERMAL CONDUCTIVITY
LIFETIME DURABILITY
LASTING BEAUTY

Always Specify and Use

HUSSEY COPPER



To design *permanence* and low cost into your products . . . specify Hussey Copper. In this ageless metal are the natural physical characteristics of outstanding corrosion resistance and unmatched thermal and electrical conductivity combined with durability and beauty. Add to these factors Hussey Copper's cost-cutting advantages of easy forming and fabrication by brazing, crimping, riveting, bolting, or laminating to other materials and you have your best all 'round answer to design-performance.

Our 102nd year
1848-1950

Sheet . . . Strip . . . Coils . . .
Fabricated Products (Rods . . .
Wire . . . Tubing . . . Nails)

COPPER **HUSSEY** BRASS

C. G. HUSSEY & COMPANY
(Division of Copper Range Co.)
ROLLING MILLS AND GENERAL OFFICES
PITTSBURGH 19, PA.

7 Convenient Warehouses to serve you promptly!
PITTSBURGH, 2850 Second Avenue • CLEVELAND, 5318 St. Clair Avenue • NEW YORK, 140 Sixth Avenue • CHICAGO, 3900 N. Elston Avenue • ST. LOUIS, 1620 Delmar Boulevard • PHILADELPHIA, 1632 Fairmount Avenue • CINCINNATI, 424 Commercial Square

Best Buy in Variable Speed!

COMPARE THESE FEATURES of *Vari-Pitch* Automatic sheave with any other variable speed drive and see why *Vari-Pitch* Automatic drive gives you more for your drive dollar.

1. Changes speeds with one hand while machine is running.
2. All mechanism is inside one sheave actuated by movement of the motor base.
3. Ample capacity and safety factor of multiple belts.
4. Full range of sizes from 1 to 40 hp.
5. Top speed is 100% higher than low speed.
6. Quiet operation.
7. Cushioned start.
8. Simple design and easy installation make cost low
9. Occupies no more space than ordinary sheave.

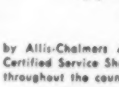
Vari-Pitch Automatic drive will pay for itself very quickly in increased production, improved quality and more flexible operation on many machines in your plant. Ask your Allis-Chalmers Authorized Dealer or Sales Office representative to give you savings and cost figures on your operations. Or write for bulletin 20B7223.

ALLIS-CHALMERS, 1171A SO. 70 ST. MILWAUKEE, WIS.

Vari-Pitch and *Texrope* are Allis-Chalmers trademarks. A-3063

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Dealers, Certified Service Shops and Sales Offices throughout the country.

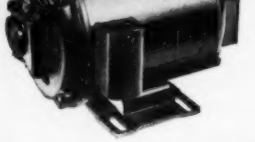


MOTORS — ½ to 25,000 hp and up. All types.

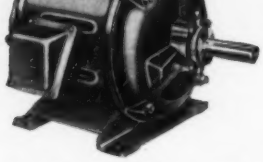
CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

PUMPS — Integral motor and coupled types from ¾ in. to 72 in. discharge and up.

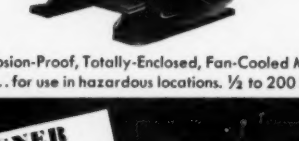
ALLIS-CHALMERS



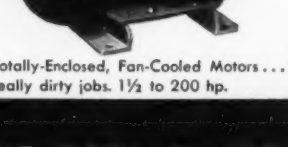
Repulsion-start Induction Motors... preferred for every single phase motor application. ⅛ to 15 hp.



Open-type Polyphase Squirrel Cage Motors...: steel frame—sleeve or ball bearing. ⅛ to 400 hp.



Explosion-Proof, Totally-Enclosed, Fan-Cooled Motors... for use in hazardous locations. ½ to 200 hp.



Totally-Enclosed, Fan-Cooled Motors... best for really dirty jobs. 1½ to 200 hp.

WAGNER MOTORS
...The choice of leaders in industry

STEP AHEAD OF COMPETITION!

...STANDARDIZE ON WAGNER MOTORS

You add a sure selling point to your product when you choose a Wagner Motor to provide always dependable power! The wide range of types and sizes of Wagner Motors permits the selection of a standard motor for practically every requirement. Their high quality and steadfast dependability have made them the standard of many leaders in industry, who have gained a competitive advantage through this choice. If you need motors that will give a minimum of trouble in the field to help *you* step ahead of competition... choose Wagner Motors.

Thirty-one branch offices, located in principal cities are ready to help you. Bulletin MU-185 gives full information on the complete line of Wagner Motors.

YOU'LL SAVE TIME, MONEY, WORRY... BECAUSE

★ Wagner Motors are immediately available from Wagner Branches in principal cities.

★ Improved engineering features assure long life and efficient operation.

★ Wagner Motors are backed by a liberal warranty.

★ They are available in a wide range of types and sizes for every application.

★ More than 450 Wagner Authorized Service Stations and Parts Distributors plus 25 Wagner-owned Service Branches provide motors, on-the-spot service, and genuine repair parts.

Wagner Electric Corporation
EST. WE 1891

WAGNER ELECTRIC CORPORATION
6370 Plymouth Ave., St. Louis 14, Mo., U.S.A.

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

BRANCHES IN 31 PRINCIPAL CITIES

M50-18

JOHN ZINK

CENTRAL GAS HEATER Can be installed anywhere . . . . . .

TWO STYLES

Here is truly a universal, efficient, simple, and compact CENTRAL HEATING UNIT. Fully automatic, it is a complete packaged unit ready for installation. The two heaters shown are almost identical in operation and design of the heat exchanger. The two different types of casings are furnished to meet requirements for a particular application.

Heaters may be installed in the basement, attic, service closet, or utility room of a home. The AF-110 may be installed even under the house if certain provisions are made for the draft diverter. For industrial applications, it may be installed on a shelf or balcony; as a suspended heater and as a duct heater.

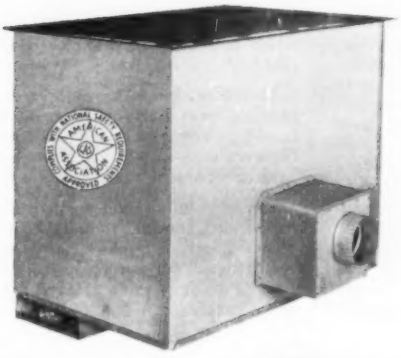
Each John Zink Central Gas Heater is equipped with an automatic safety shut-off that is really automatic.

The John Zink Central Gas Heater is designed as a winter air conditioner with a summer switch to provide air circulation during warm weather.

Gas Fired FLOOR FURNACES

A Size for Every Home Heating Requirement

Small Floor Grille • Fool Proof • Simple to Operate
AGA Approved • Sturdy Construction



SIZES
30,000 Btu input
35,000 Btu input
50,000 Btu input
50,000 Btu input (Conventional)
85,000 Btu input (Conventional)

Send Coupon for Free Literature

MAIL TODAY

JOHN ZINK CO., 4401 So. Peoria, TULSA, OKLA.

Without obligation, please send me literature on FLOOR FURNACES. ☐ CENTRAL HEATERS.

Name .....

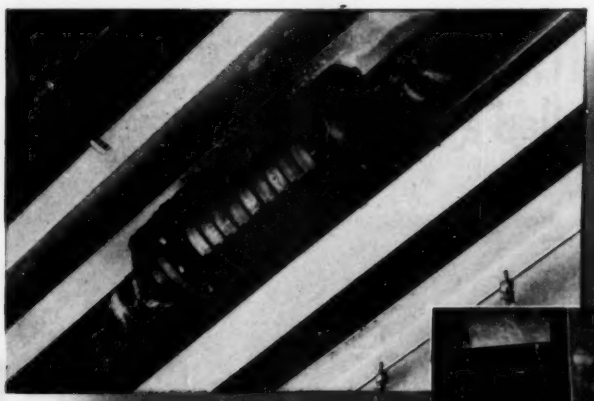
Company .....

City ..... Zone .... State .....

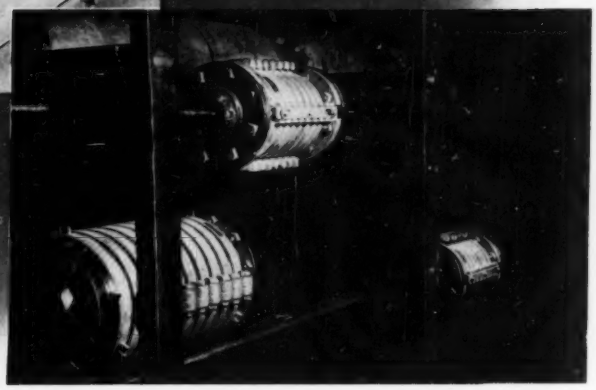
JOHN ZINK COMPANY

4401 SOUTH PEORIA TULSA, OKLAHOMA

NO MAINTENANCE HERE!



ADSCO Corruflex Joint installed in overhead steam line in a large industrial plant.



Three of the joints in tunnel piping at large state hospital.

Install ADSCO *Corruflex* PACKLESS EXPANSION JOINTS and FORGET MAINTENANCE in hard-to-reach spots!

It costs too much to service a joint thirty feet in the air or jammed in a small tunnel—and there's no need for it. ADSCO *Corruflex* Packless Expansion Joints never require packing. They need no maintenance. There are no upkeep costs.

Corruflex Joints are on the job all the time . . . absorbing pipeline expansion and contraction . . . protecting lines and equipment from undue strain.

And ADSCO *Corruflex* Joints are easy to install. Their compactness — with a maximum outside diameter scarcely larger than that of an ordinary flange — makes them ideal for use overhead or in trenches, tunnels or other cramped quarters where installation costs may be unusually high.

Like other ADSCO products, *Corruflex* Joints are built to the highest standards. They are available in sizes from 3" to 24", single or double units, single or multiple corrugations, with or without self-equalizing rings, and with flanged or welding ends. They are supplied in copper, stainless steel or other alloys and with internal sleeves if required.

Corruflex Joints have traverses ranging from fractions of an inch to 15" and operate under pressures from vacuum to 300 psi and temperatures from sub-zero to 1600 F.

For dimensions and further information, consult your ADSCO representative or send us your requirements for our recommendation. For descriptive literature, *write for Bulletin No. H-35-51.*

ADSCO offers the most complete line of expansion joints available from any manufacturer. For an impartial installation recommendation, consult the company that makes all types.

ADSCO

EXPANSION JOINTS — HEAT EXCHANGERS
STEAM TRAPS — STRAINERS — METERS
CASING — ANCHORS — GUIDES

Leaders Since 1877

AMERICAN DISTRICT STEAM CO.
NORTH TONAWANDA, N. Y.

The cafeteria of a large insurance company in New York City. • **Architect:** T. H. Engelhardt • **Engineer-Contractor:** Buensod-Stacey, New York, N. Y.

A PROBLEM IN *Beauty and Balance*

...solved by **kno·draft** adjustable air diffusers

The air-conditioning problem in this company cafeteria was to select air diffusers that would "go" with its rich design and, at the same time, balance the great heat differential between the serving and the dining area.

Kno-Draft *Adjustable* Air Diffusers solved both problems.

Notice how well Kno-Draft's clean, concise lines harmonize with paneling and chandeliers. Take a satisfied user's word for it that the pattern of air flow provides equalized temperature and thorough distribution—*without draft*—throughout the entire area.

With Kno-Draft *Adjustable* Air Diffusers, both air volume and direction are completely and easily controlled *after* installation. A screw driver is the only tool needed. Kno-Draft Air Diffusers are as much "at home" in modern as in traditional surroundings . . . and there are types and sizes to meet every requirement.

KNO-DRAFT DATA BOOK: Complete specifications, engineering and installation data on Kno-Draft *Adjustable* Air Diffusers. To get your copy, simply fill in and mail the coupon. No obligation, of course.

W. B. CONNOR ENGINEERING CORP.
114 East 32nd Street, New York 16, N. Y.
Air Diffusion • Air Purification • Air Recovery
In Canada: Douglas Engineering Co., Ltd.,
190 Murray Street, Montreal 3, P. Q.

W. B. CONNOR ENGINEERING CORP.
Dept. G-60, 114 East 32nd Street, New York 16, N. Y.

Please send me, without obligation, my copy of the Kno-Draft Air Diffuser Data Book.

Name.....

Position.....

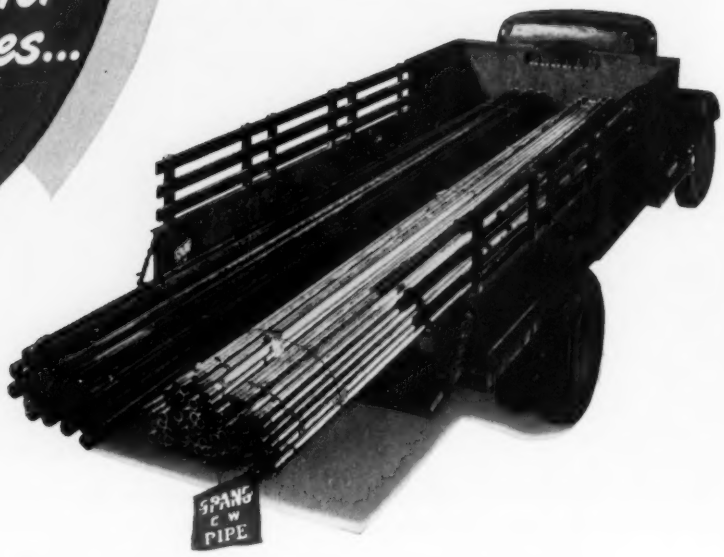
Company.....

Street.....

City.....Zone....State.....

your Spang CW distributor believes...

That good service pays



Your Spang CW Pipe Distributor makes your problems his when you call him. He knows that good, quick service means satisfied, lasting customers. And he's more than willing to go out of his way to see that you get prompt, efficient service in emergencies.

He also knows that it pays to handle products of fine quality. That's why he stocks and recommends Spang CW Pipe. He knows that Spang CW gives long, trouble-free service. One of the reasons why this is true is because of the final finishing and descaling operations in its manufacture. This assures a smooth, scale-free inside surface that minimizes dangerous and costly valve clogging.

For dependable, quick service call your Spang CW Pipe Distributor the next time you need steel pipe, fittings, fixtures, valves or other piping materials. You'll like his philosophy . . . *good service pays.*

SPANG-CHALFANT

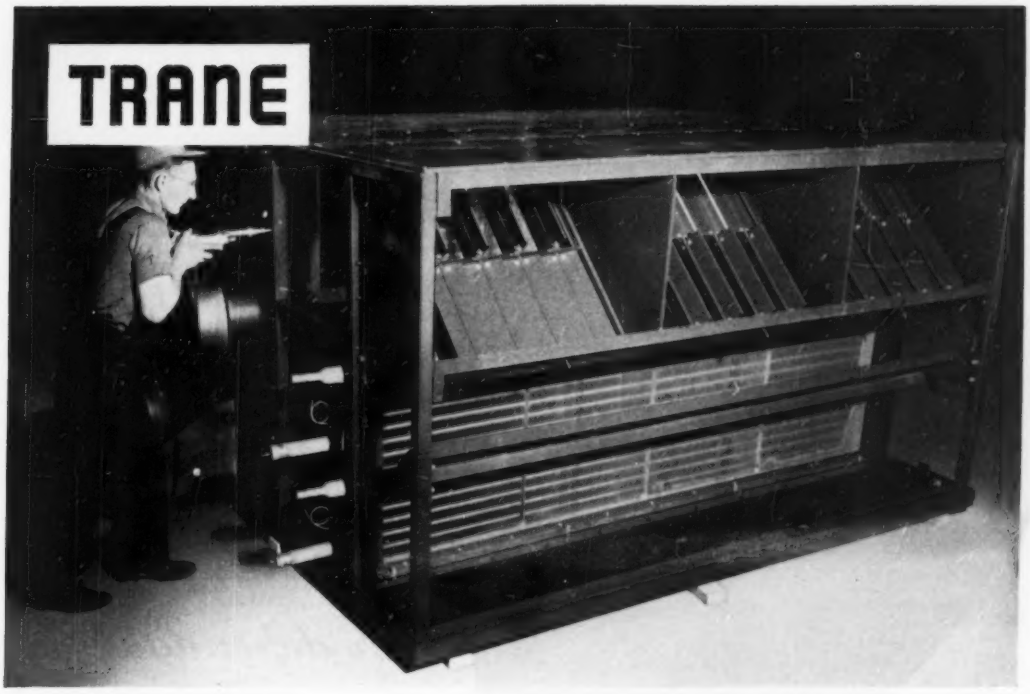
Division of The National Supply Company

EXECUTIVE OFFICES: PITTSBURGH, PA.

District Sales Offices: Atlanta; Boston; Detroit; Houston; Los Angeles; New York; Philadelphia; Pittsburgh; St. Louis

SPANG
CW

QUALITY *that is recognized wherever pipe is used*



One unit air conditions many zones

An economical and dependable answer to zoning problems is the Trane Multizone Climate Changer. One unit with *one* cooling coil—*one* heating coil—*one* motor—handles the work, in certain applications, that would normally require as many as ten, or even more, individual air conditioning units.

These versatile units are noted for their rugged construction, dependability and performance. They offer a logical method of fulfilling the variety of air conditioning demands imposed simultaneously on a building. They provide accurately tempered air to maintain design conditions.

Quick acting, thermostatically controlled dampers automatically regulate the condition of the air required to maintain the optimum conditions in every zone.

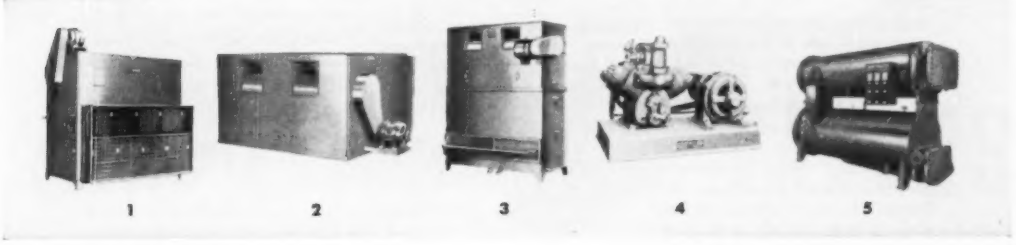
Ask the Trane sales office in your area to show you how Trane Climate Changers are being used to meet heating, ventilating, and air conditioning needs, for comfort or process, work in domestic, commercial, or industrial applications. There is a size, style and type of Trane Climate Changer to meet your specific needs.

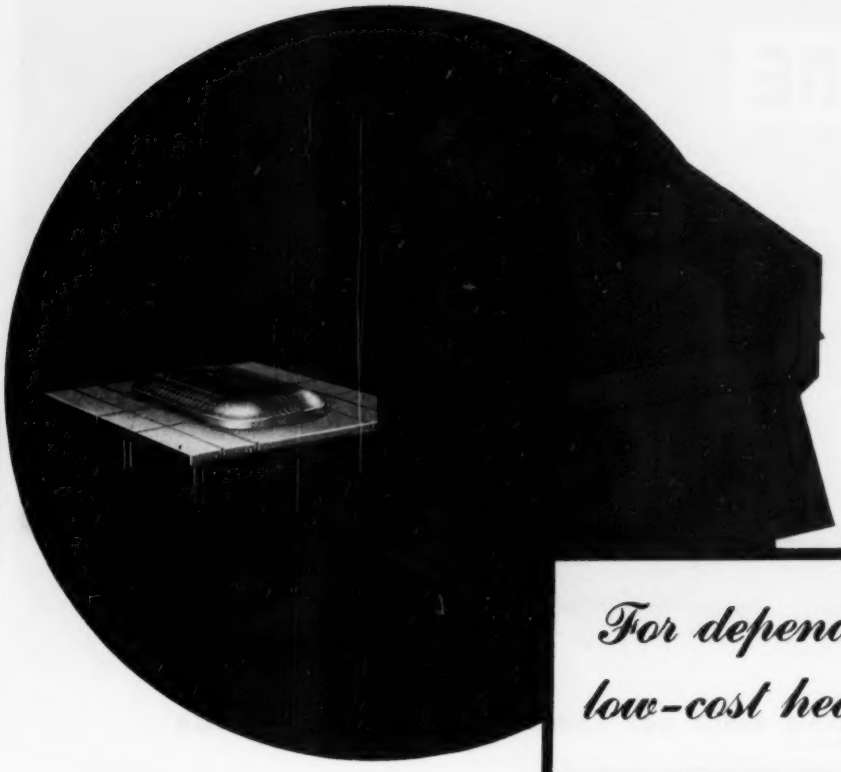
THE TRANE COMPANY...LA CROSSE, WIS.
EASTERN MANUFACTURING DIVISION, SCRANTON, PA.

Manufacturing Engineers of Heating, Ventilating and Air Conditioning Equipment—Unit Heaters, Convector-radiators, Heating and Cooling Coils, Fans, Compressors, Air Conditioners, Unit Ventilators, Special Heat Exchange Equipment, Steam and Hot Water Heating Specialties

...IN CANADA, TRANE COMPANY OF CANADA, LTD., TORONTO.

An endless variety of sizes and styles of Climate Changers, vertical (1) and horizontal (2); along with Evaporative Condensers (3); Compressor Units (4); and Turbo-Vacuum Compressors (5); are typical of the Trane line.





For dependable, low-cost heat . . .

IT'S THE

WILL-BURT STOKER

Advanced design and precise manufacture highlight the Will-Burt commercial stoker. Every part of every Will-Burt unit is designed, planned and produced for just one purpose—to provide dependable heat at low cost.

Thirty standard models are available, with capacities from 20 to 600 pounds of coal per hour. Hopper and bin-feed types throughout the entire capacity range assure you of the right size and style of stoker for your particular requirements.

You'll find Will-Burt commercial stokers wherever bituminous coal is burned—whether in Milford Center, Ohio, or Stockholm, Sweden. You'll find them in homes, churches, schools, stores and factories of all types and sizes. And wherever you find them, they'll be delivering constant, dependable heat at low cost.

Whether you buy, sell, or specify heating equipment, investigate Will-Burt. You'll find the highest in quality, backed by more than 50 years of manufacturing experience—more than 20 years experience in the design and manufacture of bituminous coal stokers. You'll find a sound dealer policy—a profit policy backed by service and quality—a policy which holds the loyalty of Will-Burt dealers year after year.

Your request for additional information will receive prompt attention.

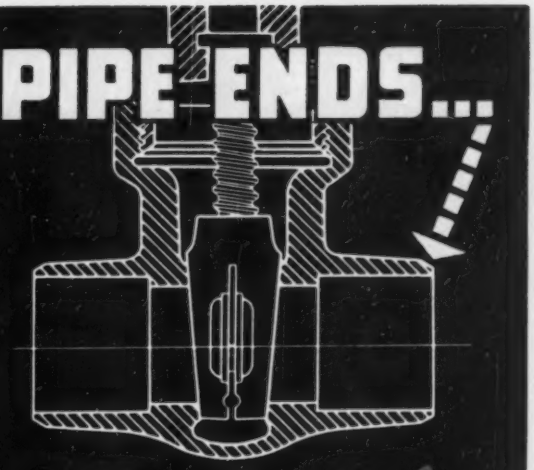
OTHER WILL-BURT HEATING PRODUCTS

Conversion oil and gas burners • Domestic oil-fired hot-water heating boilers • Coal, gas and oil-fired warm air furnaces

THE WILL-BURT COMPANY

DEPT. H ORRVILLE, OHIO

THINNER PIPE ENDS...



for Easy Soldering

NO. 6 GLOBE TYPE

100 lbs. W. S. P.
150 lbs. W. O. G.

Composition disc valve for all general service. Full swivel disc holder prevents excessive wear of either disc or seat.

NO. 7 GLOBE TYPE

100 lbs. W. S. P.
150 lbs. W. O. G.

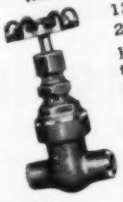
Same composition disc construction as No. 6 with addition of drain in center of body to prevent interference with pipe ends in draining.

NO. 24 GATE TYPE

100 lbs. W. S. P.
150 lbs. W. O. G.

Ideal for all full flow service for low pressure. Features the Flexitite Disc* that assures a valve that starts tight and stays tight.

No. 28 GATE TYPE



125 lbs. W. S. P.
200 lbs. W. O. G.

Hollow cored, slotted Flexitite Disc* assures all-around seal with the seat. This valve also available for same pressures in rising stem—the No. 29.

CHECK THESE NEW O-B SOLDER TYPE VALVES

Quick, even distribution of heat through valve pipe ends is a must for leak-tight, copper-to-copper connections. By careful trimming of the valve wall, O-B has produced a fast-heating pipe end. Heat-wasting excess metal is eliminated without reducing the sturdiness of the valve itself.

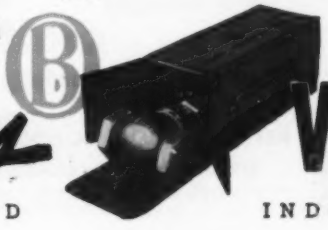
This thinner wall permits a rapid distribution ot heat through the pipe ends of the valve and assures an even flow of solder around the tubing. Carefully tapered, the pipe end walls take advantage of the inserted tubing for reinforcement resulting in a sturdy, leak-tight connection.

AVAILABLE IN THE FOLLOWING SIZES

No. 6	3/8	1/2	3/4	1	All sizes indicated in inches.		
No. 7	3/8	1/2	3/4	1			
No. 24	3/8	1/2	3/4	1	1 1/4	1 1/2	2
No. 28	3/8	1/2	3/4	1	1 1/4	1 1/2	2
No. 29	3/8	1/2	3/4	1	1 1/4	1 1/2	2

3003-V

* Reg. U. S. Pat. Office



Ohio Brass **VALVES**

FOR DOMESTIC AND INDUSTRIAL USE

BRUNNER SINCE 1906 **AIR CONDITIONING** builds business

Let's cut out the BLANDISHMENTS!

You are in business to make money. So are your customers. So are we.

Brunner put 44 years of experience and a mighty valuable reputation into the design, development and marketing of this new line of self-contained floor-type room air conditioners.

As a product we know it has the last word when answering the questions of user-buyers—price, good looks, dependability, capacity, etc., etc.

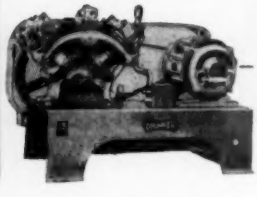
The market for self contained floor type air conditioners hasn't been scratched. It is a *big* market, easy to contact, easy to sell and unit installation is simple.

So there you are. You want more profitable business. Your potential customers need air conditioning to protect and develop their business. Brunner has the product. It costs you nothing to find out whether or not Brunner Air Conditioning really does offer a worthwhile greater income.

Write or wire for a Brunner factory representative to show you the facts.

BRUNNER SINCE 1906 **AIR CONDITIONING**

- **Self Contained 3 HP. to 10 HP.**
- **Remote Type 5 HP. to 75 HP.**



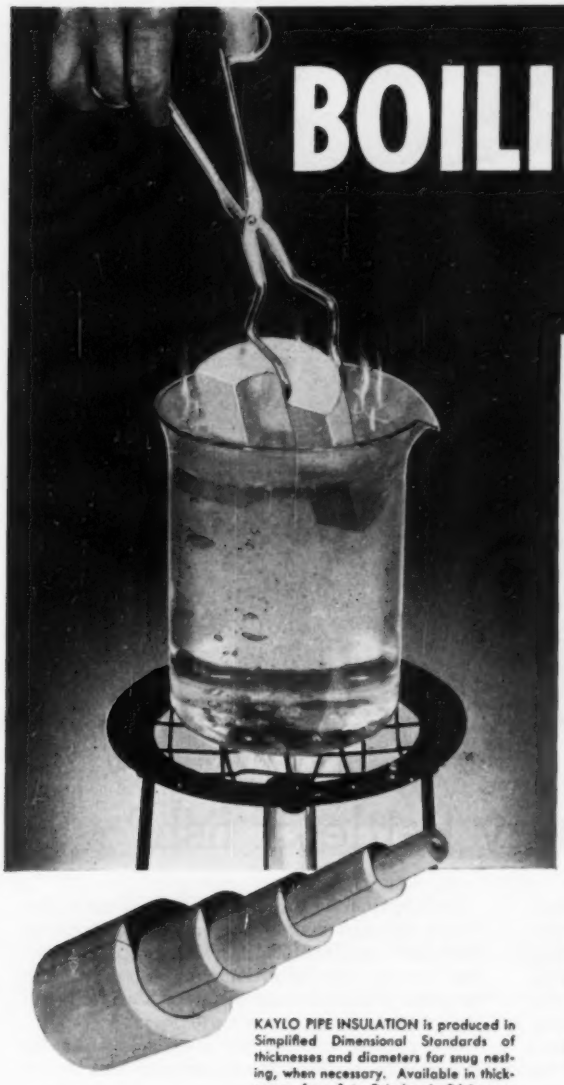
BRUNNER MANUFACTURING CO., Utica 1, New York, U.S.A.

REFRIGERATION CONDENSING UNITS by BRUNNER SINCE 1906

AIR AND WATER COOLED MODELS—*a size and type for every purpose...* **¼ HP. TO 75 HP.**

BOILING TEST

PROVES STABILITY OF KAYLO HEAT INSULATION



What insulation material will not break down under exposure to live steam or hot liquid? Answer: Kaylo Heat Insulation.

In tests, samples of Kaylo Heat Insulation have been boiled continuously for 24 hours and longer. None has disintegrated or shown any loss of insulating efficiency, after drying. Test boiling has caused no appreciable shrinking, swelling, weight loss or permanent change in Kaylo Heat Insulation.

This Inorganic Material Insulates Efficiently From 200° F. to 1200° F.

One layer of Kaylo Heat Insulation assures you of insulating efficiency from 200°F. to 1200°F.—a temperature range which often requires two thicknesses of different materials . . . and the efficiency of Kaylo insulation actually improves after exposure to service temperatures.

This remarkable new product is available in two forms: Kaylo Heat Insulating Block and Kaylo Pipe Covering. Both are exceptionally strong, lightweight and resistant to moisture damage . . . easy to handle and apply . . . neat and clean in appearance on finished jobs.

The many advantages offered by Kaylo Heat Insulation are appreciated by users in many different industries.

KAYLO PIPE INSULATION is produced in Simplified Dimensional Standards of thicknesses and diameters for snug nesting, when necessary. Available in thicknesses from 1 to 3 inches in 36-in. sections, for pipe sizes from ½ to 12 in.

KAYLO®

HEAT INSULATING BLOCK and PIPE COVERING

OWENS-ILLINOIS GLASS COMPANY
Kaylo Division • Toledo 1, Ohio

SALES OFFICES:
Atlanta • Boston • Buffalo • Chicago • Cincinnati • Dallas • Minneapolis
New York • Philadelphia • Pittsburgh • St. Louis • Toledo • Washington

SEND COUPON FOR KAYLO HEAT INSULATION SAMPLE & LITERATURE

OWENS-ILLINOIS GLASS COMPANY
Dept. N-94, Kaylo Division · Toledo 1, Ohio

Gentlemen: Please send me a Kaylo Heat Insulation sample and descriptive literature.

NAME.....

FIRM.....

ADDRESS.....

CITY.....STATE.....

Isn't this a pretty kettle of fish?

SURVEYS reveal an appalling misunderstanding among young people of the "facts of business life." For example, a poll was made among seniors in certain high schools which showed that they believe business profits are "over 50%" of the sales dollar, where actually profits average less than 8%. These students also think that stockholders receive 24% of the sales dollar, where actually it runs less than 3%.

Isn't this a pretty kettle of fish?

A greater part of the 8% of the sales dollar is reinvested in the business to expand and improve plant facilities which protects employment and creates new jobs for more workers.

Such ignorance is alarming. It is unfair to the young people themselves and dangerous to America's furture. Such misconceptions open the door to socialism, communism and all the fantasies of the handout or "something-for-nothing" state of the economic dreamers.

Our school teachers say they *want* authentic information on the business system and how it works. Only business itself can supply the facts. You as a business leader in your commuuity must share the responsibility for this misunderstanding. It is our civic duty to help overcome this misconception of everyday economics in the minds of our youth today.

THE YOUNGSTOWN SHEET & TUBE CO. 1900 YOUNGSTOWN 1950 50 YEARS OF SERVICE

The Youngstown Sheet and Tube Company

General Offices--Youngstown 1, Ohio
Export Offices--500 Fifth Avenue, New York

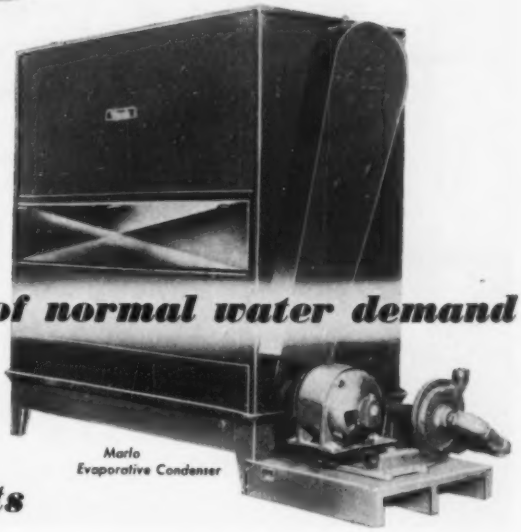
MANUFACTURERS OF CARBON ALLOY AND YOLOY STEELS

ELECTROLYTIC TIN PLATE - COKE TIN PLATE - WIRE - COLD FINISHED CARBON AND ALLOY BARS - PIPE AND TUBULAR PRODUCTS - CONDUIT - RODS - SHEETS - PLATES - BARS - RAILROAD TRACK SPIKES.

SAVED *day after day...*

up to 95%...

...of normal water demand



Marlo
Evaporative Condenser

with Marlo cooling units

Engineered for more efficient re-cycle cooling, Marlo Evaporative Condensers and Cooling Towers cut cooling water consumption up to 95%—a substantial and ***steady*** saving your clients can count on . . . just ***one*** of the big Marlo economies.

Other Marlo features that mean better installations for you . . .

Durability . . . Marlo Units last longer—with all galvanized construction that resists corrosion.

Quietness . . . Sound-deadening interiors, silent V-belt drive assure low noise-level operation.

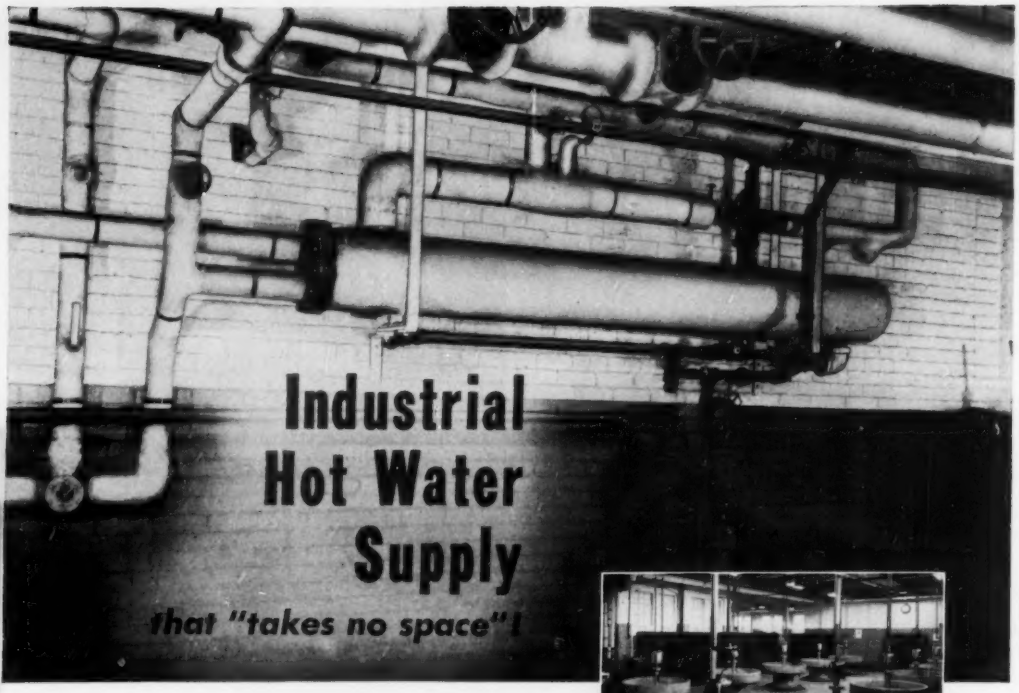
Compactness . . . Marlo Units are installed easily—with minimum expense.

Accessibility . . . for fast, simple, economical servicing.

Write for complete details on Marlo Evaporative Condensers and Cooling Towers.

MARLO HEAT TRANSFER
Since 1932

Marlo COIL CO. • 6135 Manchester Rd. • St. Louis 10, Mo.



Industrial Hot Water Supply

that "takes no space"!

This General Instantaneous Water Heater installation at Nicholson File Company supplies 96 gpm at 125° F. for 12 Bradley wash fountains in the Cutting Dept. washroom.

Think of all the headaches avoided by this compact, simple G F hot water heater that supplies 96 gals. of 125° water a minute. No space problem, because it's mounted on the wall . . . out of the way. No major construction is involved either, because it has no tank, no complicated piping. Installation required minimum of planning, minimum amount of work. And the unit is located near the washroom . . . no long runs of piping, no heat waste.

Maybe you have a similar water heating problem that can be solved as economically and as easily. General Instantaneous Water Heaters supply up to 300 gallons of clean hot water a minute through seamless copper tubing . . . 19 sizes, the largest measuring less than 15″ by 120″. Heated with steam through shell . . . all waterways non-corroding bronze or copper.

Here's the efficient way to boost hot water capacity without building an addition to your plant or crowding your boiler room. Why not get all the details? Send for new Catalog No. 19. General Fittings Co., A-123 Georgia Avenue, Providence 5, R. I.

GENERAL instantaneous water heaters

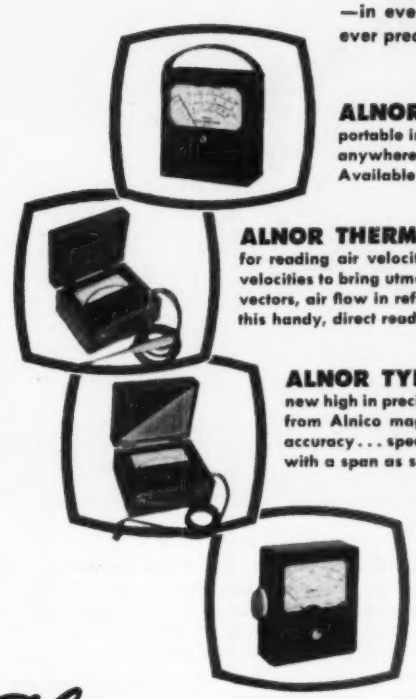
Products of General Fittings Co., makers of Tankless and Indirect Water Heaters and Heating Specialties.

General Instantaneous Water Heaters 19 sizes up to 300 g.p.m.

Alnor OFFERS YOU FOUR WAYS TO Save Time ...Save Money!

Time spent in needless rechecking, balancing and adjusting of heating and air conditioning systems is a waste. It can easily account for much of the cost on every installation and service job.

Here are four Alnor precision instruments that help you do a better job—faster, at lower cost. And like all Alnor instruments —in every industry—the ones shown here are favorites wherever precision and fine craftsmanship are essential.



ALNOR VELOMETER . . . is a precision-built, self-contained, portable instrument that gives instant, accurate readings of air velocities anywhere. Needs no calculations or reference charts . . . is direct reading. Available in wide scale range. Write for Bulletin No. 2448-G.

ALNOR THERMO-ANEMOMETER . . . is a compact, simple instrument for reading air velocities as low as 5 f.p.m. It makes possible fast adjustment of velocities to bring utmost comfort . . . efficiency. Drafts within rooms, flow from convectors, air flow in refrigerated spaces—all these and many more are ideal uses for this handy, direct reading precision instrument. Send for Bulletin 913.

ALNOR TYPE 2300 SURFACE PYROMETER . . . sets a new high in precision measurement of low surface temperatures. Special design from Alnico magnet to finest, quick reacting thermocouple assures unfailing accuracy . . . speed and dependability. Available in 5 Fahrenheit scale ranges with a span as small as 150°. Send for Bulletin.

ALNOR VELOMETER JR. . . . ideal for taking a quick, accurate check on circulation and diffusion of air. Sturdily built, carefully calibrated, the palm-sized Velometer Jr. gives instant reading of air velocities without timing, reference charts, etc. Send for Bulletin No. 725.

Alnor

PRECISION INSTRUMENTS FOR EVERY INDUSTRY

420 North LaSalle Street • Chicago 10, Illinois

Illinois Testing Laboratories, Inc.
Room 513, 420 N. La Salle Street, Chicago 10, Ill.

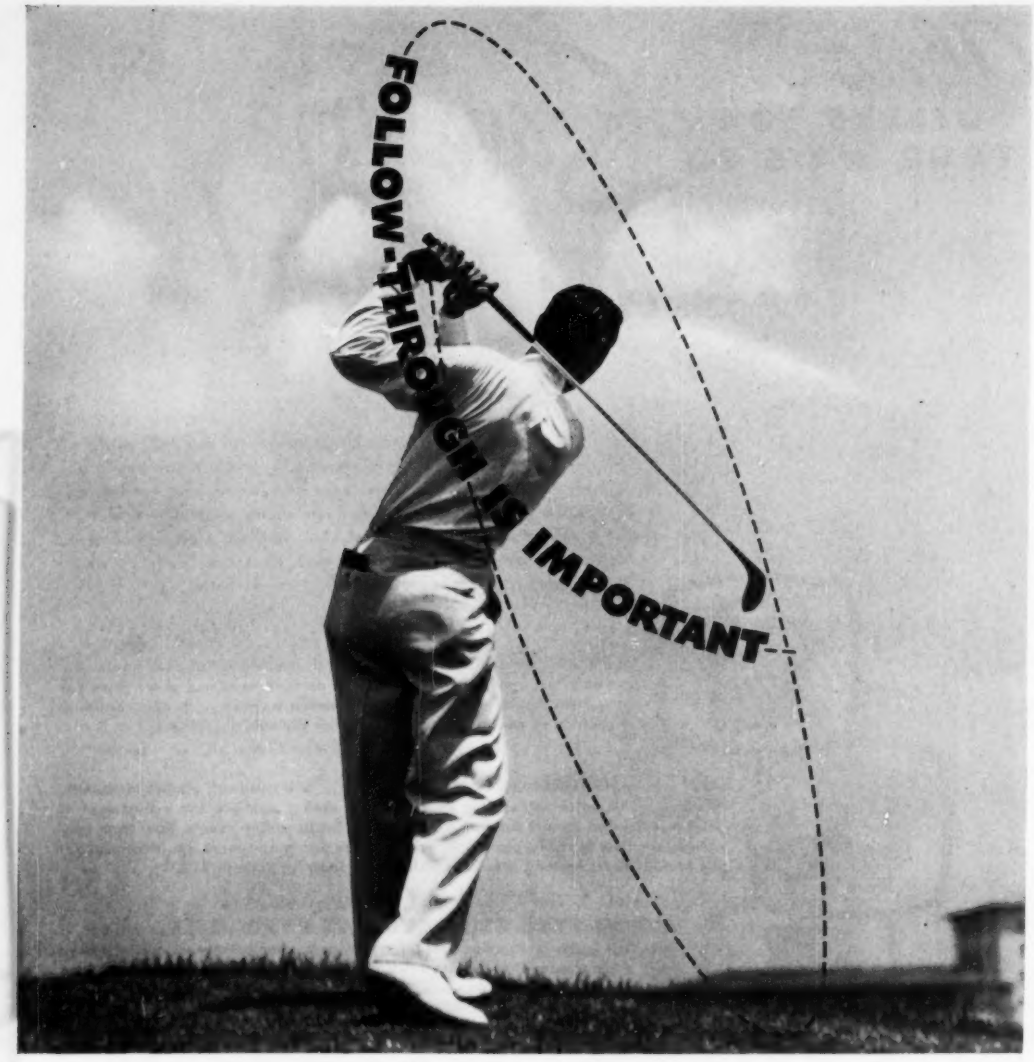
Send complete information on the following:

☐ Velometer ☐ Thermo-Anemometer
☐ Type 2300 ☐ Velometer Jr.

Name.....

Address.....

City.....Zone.....State.....



A good set of clubs and proper instruction will help your game, but without follow-through on that swing you'll never break a hundred.

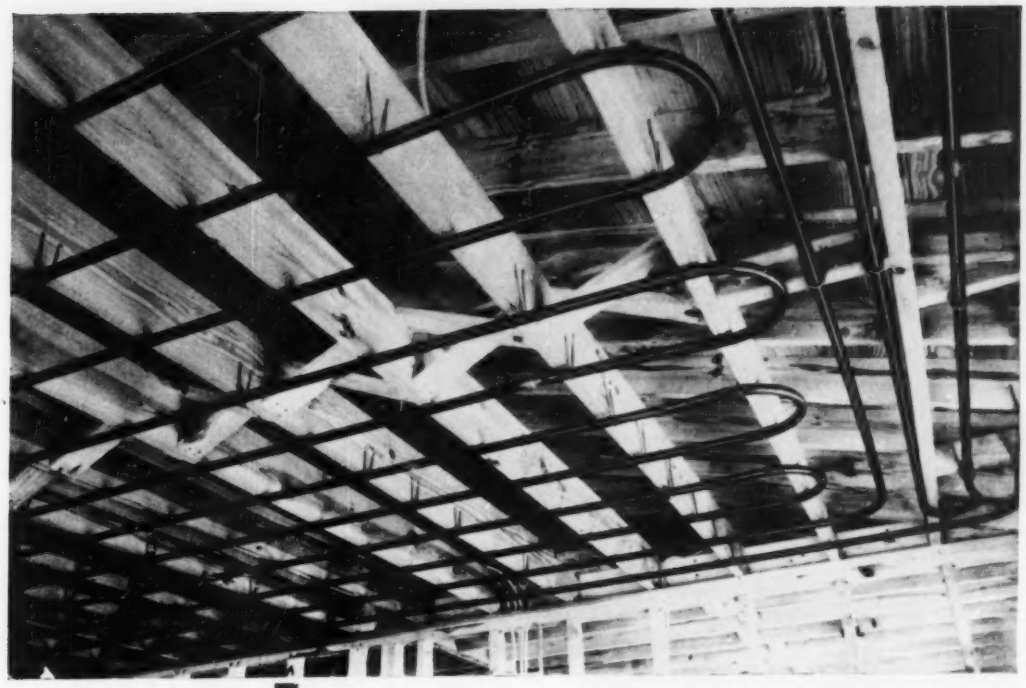
Follow-through is important in air conditioning, too. Carrier engineers have years of experience and know-how behind them. And follow-through on every installation has helped to make Carrier the leader in air conditioning.

Carrier offices are located in most major cities and are ready to give prompt assistance, from planning the installation to making sure that it gives your customer dependable, low-cost service. The Carrier name is accepted everywhere as synonymous with efficient, economical air conditioning.

Carrier offers the most complete selection of air conditioning equipment on the market. For multi-room installations there are the Weathermaster systems, which provide year-round individual control of each room. For other installations there are Carrier Weathermaker units, central air conditioners, as well as a complete line of refrigerating machines. The name "Carrier" stands for the finest engineering and the finest equipment money can buy. Carrier Corporation, Syracuse, New York.

Carrier

AIR CONDITIONING
REFRIGERATION • INDUSTRIAL HEATING



This residential radiant heating ceiling panel, fabricated of Republic Steel Pipe, includes approximately 207 bends. After it had been suspended from ceiling joists and metal lath had been wired to the underside, the entire panel was plastered to form one continuous radiant surface.

Every Bend RIGHT ON THE BEAM

● Republic Steel Pipe rates high for radiant heating.

Made by Republic's own advanced Continuous Weld Process, it is highly ductile, easy to fabricate, especially *suited to close coiling and bending.*

Having an expansion co-efficient equal to that of plaster and concrete, it is perfectly adaptable to ceiling, sidewall or floor radiant panels.

It comes to you in long lengths that speed-up installations by reducing the number of joints. It welds readily by all standard methods.

Republic Steel Pipe adds one more advantage to all these—Economy. You need nothing more costly than steel pipe for closed radiant heating systems. That fact is proved beyond question by the remarkably trouble-free record of steel pipe, standard over the years for all closed heating systems.

What's more, today's improved Republic Continuous Weld Pipe is an even better buy than that which began to serve you so well twenty years ago.

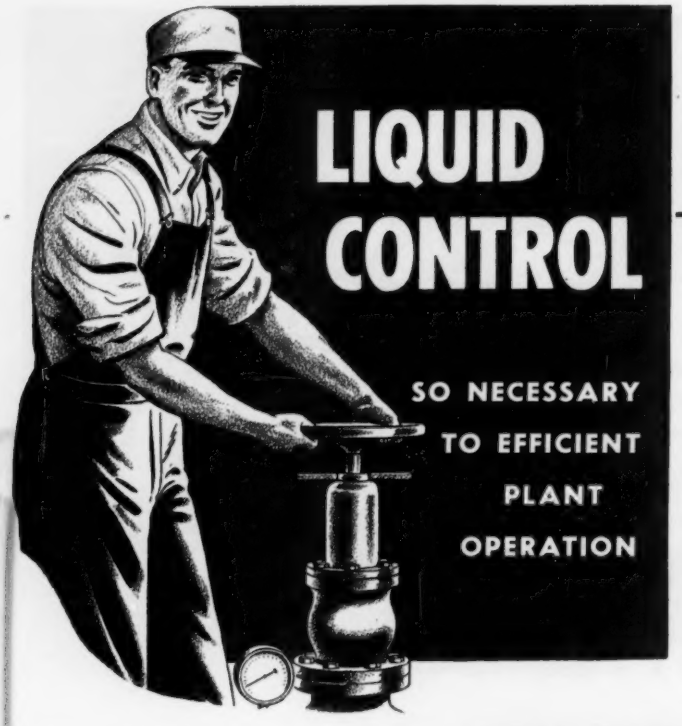
Your Republic Pipe Distributor will be glad to give you more facts, including latest information on available sizes and current delivery schedules. See him soon.

REPUBLIC CONTINUOUS WELD PIPE

Uniformly Strong
Uniformly Ductile
Uniformly Clean and Scale Free
Easy to Weld by All Modern Methods
Easy to Bend, Thread and Close Coil
Economical Uniform Lengths, Extra Long Lengths
Uniform Wall Thickness, Diameter, Concentricity
Expansion Co-efficient Same as Concrete and Plaster

REPUBLIC STEEL CORPORATION
GENERAL OFFICES • • CLEVELAND 1, OHIO
Export Dept.: Chrysler Building, New York 17, New York

Republic STEEL PIPE
IS FIRST CHOICE

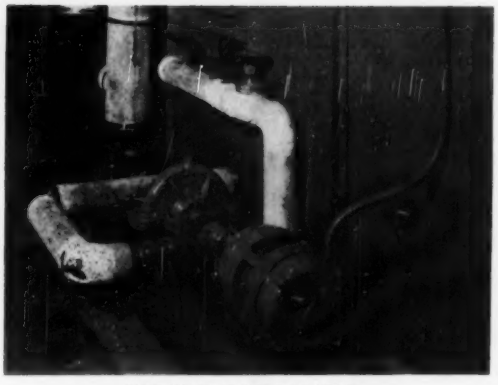


LIQUID CONTROL

SO NECESSARY TO EFFICIENT PLANT OPERATION

BE *Sure* OF IT SPECIFY "Buffalo" PUMPS

Getting your liquids where you want them in the right volumes at all times—***liquid control*** — must be backed up by DEPENDABLE PUMPS! "Buffalo" pumps have a reputation throughout industry for this kind of service. Extra heavy construction in every part—plus efficient design—are the reasons. DON'T LEAVE ***YOUR*** LIQUID CONTROL TO CHANCE. Write for Bulletins 955-N and 980-B for helpful facts on any service you need.



"BUFFALO" CLASS "SL" PUMP ON AIR WASHER SERVICE

"Buffalo" PUMPS

BUFFALO PUMPS INC.

171 MORTIMER STREET BUFFALO, NEW YORK

Canada Pumps Ltd., Kitchener, Ont.

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID

Branch Offices in all Principal Cities

T F

...easier and better the WeldELL way

For the *practical* facts about pipe welding fittings go to the *practical* men...the welding foreman; the pipe fitter foreman; the construction superintendent... who have used all kinds and know the field.

They will tell you that the job moves faster and costs stay down when WeldELLS and other Taylor Forge fittings are used

...because of the precision quarter markings, the sized end tangents, the accurate machine tool bevels and lands.

They will tell you that the job maintains momentum easier, smoother

...because of the completeness of the line and better identification markings.

They can tell you...at least, design men will...that the *finished* job is better

...because it is done with fittings that are engineered down to the last detail to meet all requirements of *every job*.

Yes, "WeldELLS have everything"...to make it *easier ...better*. Coupon brings lots of facts.

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TAYLOR FORGE & PIPE WORKS • *General Offices & Works:* Chicago 90, Ill. (P.O. Box 485). *Eastern Plant:* Carnegie, Pa. *Western Plant:* Fontana, Calif. *District Offices:* New York: 50 Church Street. Philadelphia: Broad Street Station Bldg. Pittsburgh: First National Bank Bldg. Chicago District Sales: 208 S. LaSalle Street. Houston: City National Bank Bldg. Los Angeles: Subway Terminal Bldg.

Please send a copy of your new welding fittings and forged steel flange catalog 484

Name_____

Position_____

Company _____

Street Address_____

City_____ Zone____ State_____

Mail to Taylor Forge & Pipe Works
P.O. Box 485, Chicago 90, Ill.

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FOR Hard-to-Start Jobs

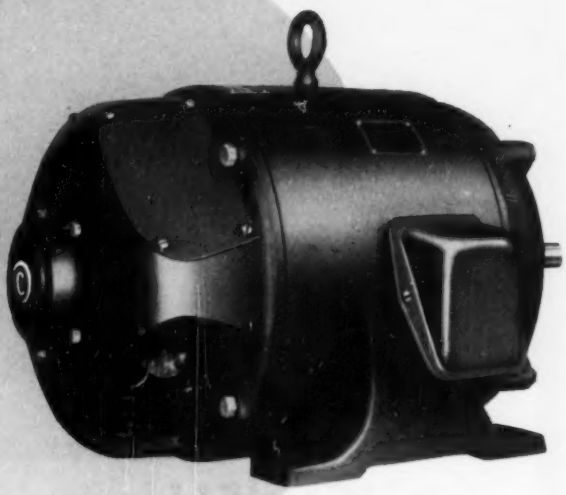
Requiring Low Starting Current

SPECIFY

Century

TYPE RS*

MOTORS



** Single Phase, Repulsion Start, Induction, Brush Lifting Motors*

Century SERVICE

Is Near Any CENTURY Motor Driven Equipment

Satisfactory performance of CENTURY products is assured by more than 200 CENTURY Authorized Service Stations supervised by 28 CENTURY Sales Offices.

1. Facilities for immediate exchange of most CENTURY standard ratings of standard construction are available at CENTURY Authorized Service Stations.
2. CENTURY Authorized Service Stations are qualified and equipped to service and repair any piece of CENTURY apparatus.
3. Genuine CENTURY renewal parts are available at CENTURY Service Stations, CENTURY Parts Distributors and at the factory in St. Louis.

You will find that these rugged, dependable motors meet the starting, accelerating and running characteristics of such equipment as refrigeration compressors, air compressors, stokers, reciprocating pumps, and other hard-to-start loads.

For more than 47 years, Century Type RS motors have given satisfactory service throughout the world. They are available in sizes from ½ to 20 horsepower, in drip proof and splash proof frames.

In addition, Century builds electric motors in a wide range of types and kinds—in sizes from 1/6 to 400 horsepower for operation on single and polyphase and direct current. Specify Century motors for all your electric power requirements.

ALTERNATING CURRENT MOTORS

POLYPHASE

Squirrel Cage Induction—1/6 to 400 H.P.
Wound Rotor Motors—1 to 400 H.P.
Synchronous Motors—20 to 250 H.P.

SINGLE PHASE

Split Phase Induction—1/6, 1/4, 1/3 H.P.
Capacitor—1/6 to 20 H.P.
Repulsion Start, Brush Lifting, Induction—1/2 to 20 H.P.

DIRECT CURRENT MOTORS

1/6 to 300 H.P.

GENERATORS

AC, .63 to 250 KVA
DC, .75 to 200 KW

GEAR MOTORS

1/8 to 1-1/2 H.P.

MOTOR GENERATOR SETS

AC to DC, AC to AC
DC to DC, DC to AC

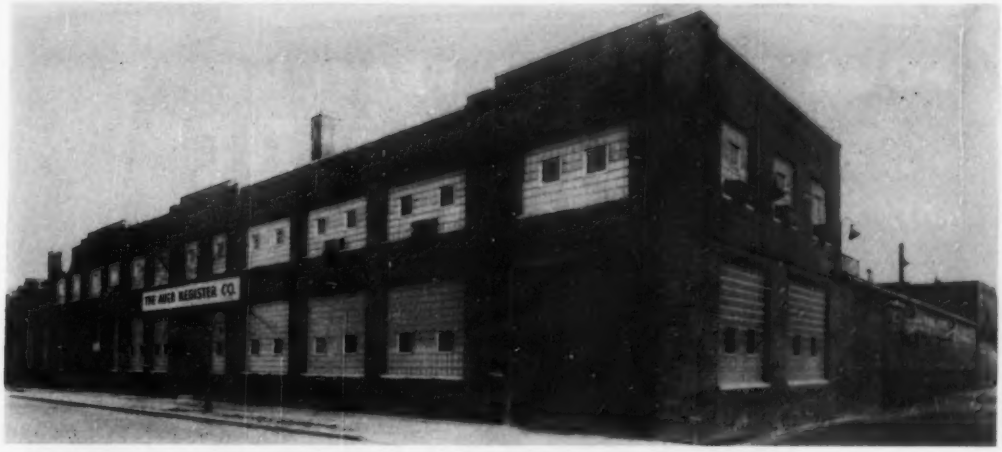
Open Protected, Splash Proof, Totally Enclosed Fan Cooled, Explosion Proof.

Ball Bearing motors are factory lubricated for several years' normal service. Bearing housing construction permits easy re-lubrication when unusual service demands it.

Century C MOTORS

CENTURY ELECTRIC COMPANY
1806 Pine St., St. Louis 3, Missouri
Offices and Stock Points in Principal Cities

672

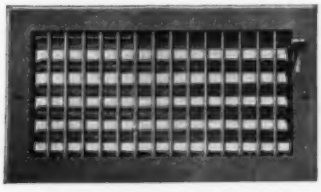


A New Home for the AUER REGISTER Organization!

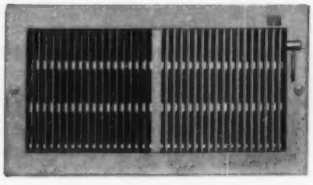
Greater demand for all our products has made it necessary for us to expand production facilities. We have purchased and now occupy the large and up-to-date plant shown above, which gives us greatly increased working area (50,000 sq. ft.), houses all of our activities under one roof, and also permits us to *streamline* the production and finishing of all Auer Registers and Grilles. Additional new automatic processing, handling, and conveyor equipment for this plant—the most modern and efficient available—is now in place and functioning. This will allow us to speed up the production of all Auer models, and, we believe, not only to maintain but to enhance their quality. It will also enable us to hold to a minimum the cost to you of Auer Registers and Grilles.

In this new home we expect to be able to serve you even better than in the past 40 years, and to make it still more worth your while to consider this Company your *standard* source of supply for all heating and air conditioning register needs.

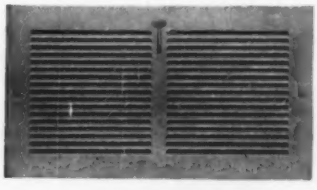
Write for complete Auer Register Book— or separate Catalog "G" on perforated Grilles.



No. 1005V-HML—Streamliner Register with single bank of vertical bars, multi-louvre shutters



No. 4432—Airo-Flex Multi-valve Register—4-Way Directional



No. 7032—Airo-Flex Single Valve Register—Adjustable Fins

THE AUER REGISTER COMPANY

6600 Clement Avenue, Cleveland 5, Ohio

CANADIAN DISTRIBUTOR, MARCHAND FURNACE, LTD., TILBURY, ONT.

Auer REGISTERS

& GRILLES for AIR CONDITIONING & GRAVITY

FOUR ESSENTIAL FEATURES found only in SHAFCONAIRE*

SHAFCONAIRE! It's the *original* overhead furnace known for years as SHAFCO. And it's the only furnace of its type that has been time-tested, proved-in-use over 12 long years of actual field operation. That's of prime importance to you, too. Because, regardless of a manufacturer's claims and written guarantees, time . . . and time alone . . . offers the only positive proof of the merits of any product. It's your one best assurance of quality, performance, and dependability.

So take a good look at SHAFCONAIRE OVER-HEAD HEATERS. Look under the casing . . . at the all-important inside furnace construction details. See for yourself the exclusive, essential, patented features that have made SHAFCONAIRE the leader of its field, the outstanding quality "buy" on the market today!

1 **BUILT-IN PLENUM CHAMBER**—This exclusive patented SHAFCONAIRE feature saves you plenty of time and trouble in making installations. It's engineered and sized to handle capacity of the furnace. Assures uniformly heated warm air output, improves operating efficiency, reduces installation costs. Eliminates necessity of on-the-job sizing and extra sheet metal work. Ducts may be quickly, easily tapped off from end, top, and both sides to meet installation requirements.

2 **HEAVY DUTY FURNACE**—Use of heavy gauge welded boiler plate construction assures long-life, trouble-free performance. No strains, no warping, no buckling. No burn-outs common to stamped steel fabrication.

3 **INTERMEDIATE HEAT-TRAVEL SECTION**—Patented intermediate chamber between refractory-line firebox and heavy gauge heat exchangers serves to spread flame, permit expansion of hot gases. Effectively prevents impingement of flame on metal, increases life and overall operating efficiency of the furnace.

4 **EFFICIENCY ENGINEERED HEAT EXCHANGER**—Alternately spaced baffle plates in each heat exchanger section effectively retards flow of hot gases toward stack connection, permits maximum transfer of heat through the exchanger.

OVERHEAD HEATERS, INC.

(Formerly SHAFCO Distributing Corporation)

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OVERHEAD HEATERS, INC.
1354 Book Building • Detroit 26, Michigan

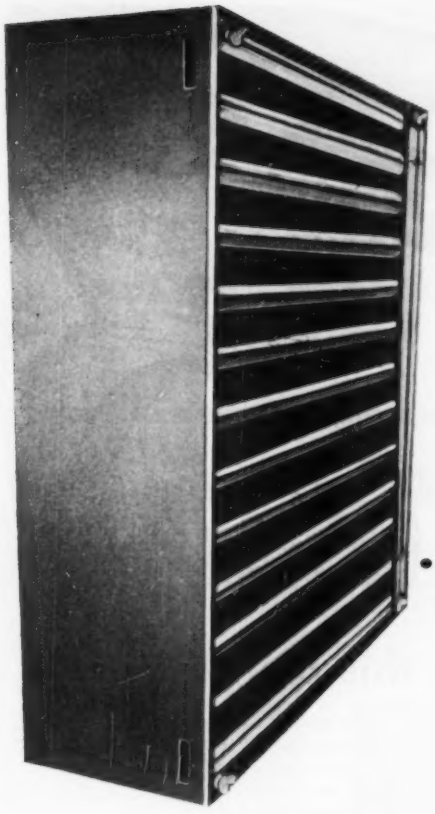
Please send me complete information and price lists on your SHAFCONAIRE (formerly SHAFCO) OverHead Heaters.

*Name*_____

*Address*_____

*City*_____ *Zone*____ *State*_____

*SHAFCONAIRE, the original overhead furnace formerly known as SHAFCO. Designed, engineered, and built exclusively for commercial and industrial applications. Models from 100,000 to 405,000 B.T.U. Backed by over 12 years actual operation in the field. Send in coupon today for complete details and price information.



We sell "C" cells

...that materially reduce the cost of air conditioning

The picture shows a Dorex Type C Air Recovery Cell. In an air conditioning system or unit, it purifies the air, improves ventilation, saves cooling and heating costs by reducing necessary intake of new, outside air as much as two-thirds.

Notice the "accordion pleats." They contain Dorex *Activated* Carbon. As used air flows through the "C" Cell, this special carbon extracts and retains all odorous, vaporous and gaseous impurities—just as a gas mask would. Stale air is purified, made fresh and completely reusable.

A double saving results from the use of Dorex Type C Air Recovery Cells. (1) Initial air conditioning equipment costs are less because, obviously, less heating and cooling capacity will be required. (2) Operating costs come down—because it costs only about half as much to freshen used air as to condition new air.

Dorex Air Recovery has proved its effectiveness in more than 6,000 installations over the past 20 years. If you do not have complete information in your files on how Dorex works, who uses it, and its great advantages to you and your clients—let us send it to you. Just mail the coupon below.

DOREX
Air Recovery

W. B. CONNOR ENGINEERING CORP.
114 East 32nd Street, New York 16, N. Y.
Air Diffusion • Air Purification • Air Recovery
In Canada: Douglas Engineering Co., Ltd.,
190 Murray Street, Montreal 3, P. Q.

W. B. CONNOR ENGINEERING CORP.
Dept. A-60, 114 East 32nd Street, New York 16, N. Y.

Please send me, without obligation, full information on Dorex Air Recovery.

Name.....

Position.....

Company.....

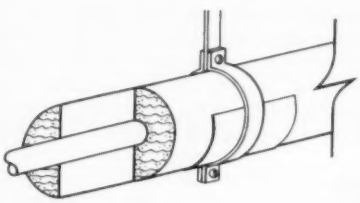
Street.....

City..... Zone..... State.....

What's wrong with this picture?

Here you see one reason why so many cold line insulation jobs are needlessly expensive. When a line is carried by small hangers just the size of the pipe, the workman will have to spend a lot of time cutting the covering to fit snugly around the hangers. Then he'll have to box in any part that extends beyond the covering, as well as insulate the hanger rod to prevent frost formation on the rod itself. Not only is this method time consuming, but it makes a good, moisture-resistant and airtight sealing job extremely difficult to obtain.

The right way is simply to use hangers large enough to fit around the insulation. Pipes can be supported by blocks of wood until the covering is applied. There's no cutting, no patching, no extra insulation and application time. Costs are reduced, and the insulation job will last longer and look better.



Armstrong's Cork Covering is strong and resilient, will readily support the weight of the piping if a simple sheet metal shield between hanger and covering is used to distribute the weight of the load.

Advice as to the best way to do any insulation job, hot or cold, is a free service of the engineers representing the Armstrong Cork Company. If you consult these men while your work is in the planning stage, they can often offer suggestions that will save you time and money. The complete contracting service they represent also brings you quality insulating materials and the services of skilled workmen to apply them. Call the Armstrong office nearest you or write to Armstrong Cork Company, 4406 Concord Street, Lancaster, Pa., the next time you have an insulation job in the offing.

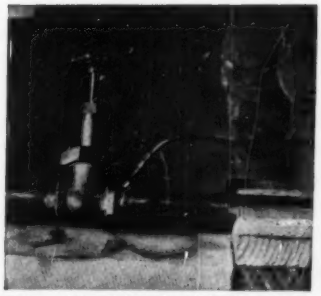
ARMSTRONG'S INDUSTRIAL INSULATIONS

MATERIALS · INSTALLATION

FOR ALL TEMPERATURES FROM 300°F. BELOW ZERO TO 2800°F.

The UN Secretariat is a **TRULY MODERN** building

...**SILBRAZ**® *joints are installed*



Making a Silbraz joint with a Walseal Gate Valve at UN, work being done at bench.

New UN Secretariat Building, N. Y. C.
Syska and Hennessy, Inc., *Consulting Engrs.*
Fuller-Turner-Walsh-Slattery, Inc.,
General Contractor
Eugene Duklauer, Inc., *Plumbing Contractor*
Almirall & Company, Inc.,
Heating Contractor

Installing a Walseal fitting at UN, on location; note operator progressively heats small section of the fitting.

Architects and builders know that it takes modern building components to make a modern building. That's why the first skyscraper erected on the site of the United Nations' buildings has brass and copper pipe runs joined with Silbraz joints—the modern way of joining brass or copper pipe or Type B copper tubing. Silbraz joints are silver brazed—not soldered or threaded—and are stronger than the pipe itself. They are leakproof, permanent, and will not creep or pull apart under any condition which the pipe or tubing can withstand. They literally form "one-piece pipelines" that save money by eliminating leaky connections, costly maintenance, and repairs.

Walseal® Valves and Fittings for making Silbraz Joints

The Walworth Company manufactures a complete line of Walseal Valves, Fittings, and Flanges for making Silbraz joints. The Walseal material used in the United Nations building was furnished by Glauber, Inc., and Asco Supply Company, Inc., both of New York City.

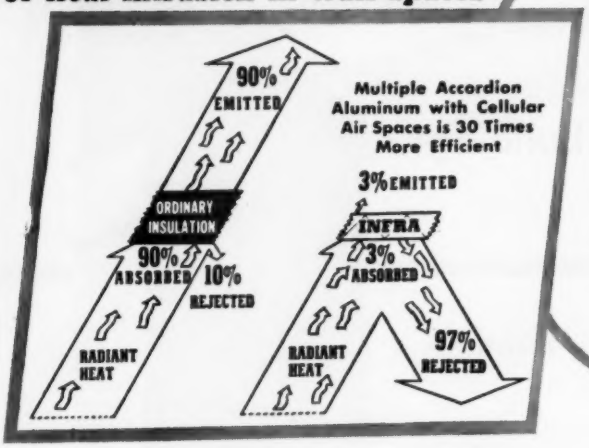
For further information regarding Walseal Valves, Fittings, and Flanges for making Silbraz joints, see your nearest Walworth distributor, or write for Circular 84B.

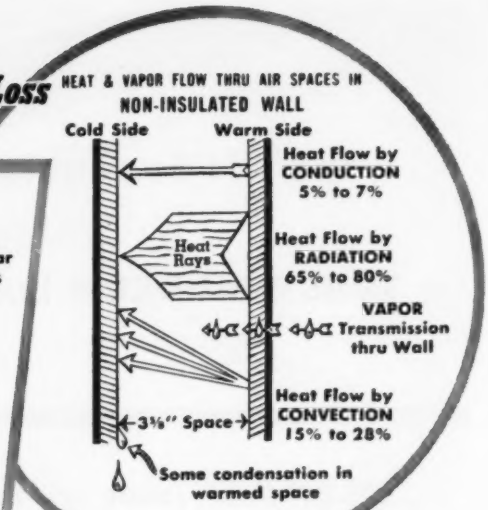
Make it a "one-piece pipeline" with Walseal

WALWORTH
valves and fittings
60 EAST 42nd STREET, NEW YORK 17, N. Y.

ALL AUTHORITIES AGREE—

Radiation Causes 65% to 80% Heat Loss Or Heat Intrusion in Wall Spaces




HEAT & VAPOR FLOW THRU AIR SPACES IN NON-INSULATED WALL
Cold Side
Warm Side
Heat Flow by CONDUCTION 5% to 7%
Heat Rays
Heat Flow by RADIATION 65% to 80%
VAPOR Transmission thru Wall
Heat Flow by CONVECTION 15% to 28%
3⅛" Space
Some condensation in warmed space

Prof. E. R. Queer, of Penn. State College, in "Importance of Radiation and Heat Transfer Thru Air Spaces," published by the Amer. Society of Heating and Ventilating Engineers, states:

"It has been generally supposed that most of the heat lost through air spaces of building structures was by conduction and convection. However, this is not the case; most of the heat transferred between conventional building materials is by radiation.

"Approximately 75% of the total heat transfer is by radiation."

Convection through air spaces in walls combined with conduction accounts for 20% to 35% of heat flow. Most of the flow, winter or summer, from warm wall to cold, is radiant, effectively barred by multiple layers of accordion aluminum permanently compartmented with cellular reflective spaces. Their slight mass and the spaces bar conduction, their construction blocks convection.

Multiple Accordion Cellular Aluminum Reflects 97% of Heat Rays; Emits 3%

Thick aluminum is absolutely impervious to water vapor, and pushes out fortuitous vapor.

The commercial form of multiple sheet accordion aluminum with permanent reflective cells is Type 4 and Type 6 Infra Insulation, costing respectively, less than 7½¢ sq. ft. and 9¢ sq. ft., material and labor, in new construction between wood joists.

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Down-Heat C.044, R22.72 equals 7½" DRY Rockwool
Up-Heat C.080, R12.50 equals 4" DRY Rockwool
Wall-Heat C.073, R13.69 equals 4½" DRY Rockwool
VAPOR PERMEABILITY equals ZERO

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THE EDITOR'S PAGES

ENGINEERING MEETINGS and conventions are of course held throughout the year, but the big load—editorially speaking—usually comes around the first of the year and in the middle of it. We list the dates and places for these affairs well in advance in our monthly columns headed Meetings & Conventions, so that you can make your plans to attend those of particular interest to you. . . . After the meeting, we publish a report on the information given there of interest to heating, piping and air conditioning engineers and contractors so you'll have the essentials (at least) of what happened in case other demands on your time prevented your attendance. Sometimes our report is in the form of a regular "story" on the meeting, in other cases it's an abstract or summary of the important papers, and frequently it may be in the form of reviews of the papers presented, in our New Books & Reports department. . . . Printers' deadlines being what they are, we can't always run our story in the issue immediately following the meeting, in which case it follows "in our next." . . . We hope you find in our columns the information you want on the meetings and conventions in which you are interested. If you don't, let us know and we'll try to do a better job of this important editorial function.

CONSTRUCTION RECORDS AGAIN BROKEN

CONSTRUCTION records were broken for the second consecutive month with April's building and heavy engineering contract awards amounting to $1,350,496,000; topping by more than $50,000,000 the preceding month's all-time high, according to F. W. Dodge Corp. Prior to last March the former record was $1,190,264,000, reached in June of wartime 1942. The April figure showed a 4 percent increase over the preceding month and a 60 percent rise over April, 1949.

Residential awards in April accounted for almost half of the month's total operations. The total in that classification was $674,836,000. Nonresidential projects amounted to $448,619,000 to show a 42 percent increase over the corresponding month in 1949 but a 10 percent drop compared with the March 1950 figure. Heavy engineering rose slightly over the preceding month and April 1949. The total for April 1950 was $227,041,000.

Nonresidential operations in the first four months of this year rose 33 percent from $1,087,589,000 last year to $1,450,138,000 this year. Residential awards for the same period aggregated $1,954,470,000; more than double the total for the same four months of last year.

Heavy engineering awards also increased this year. This classification jumped to $756,474,000 representing a 17 percent rise over last year's four months figure.

NDHA STUDIES USE OF STEAM FOR COOLING

THE SUMMER maximum demands of electric utilities are approaching the magnitudes of the winter maximum demands of these same companies, according to a note in the Bulletin of the National District Heating Association. Generally speaking, their summer capacities are somewhat less than those in the wintertime because some units are not available for service due to

AIR CONDITIONING A "MUST" FOR DRIVE-IN BANK BOOTH

WITH AMERICA more in a hurry than ever before, many banks throughout the United States are adopting drive-in teller booths to streamline service.

With a little ingenuity, banks can overcome the heating and cooling problems which are generally connected with these teller booths, especially if they are located along the curbing, says the York Corp.

The problem of the Amarillo National bank was the year 'round air conditioning of its drive-in teller booth erected on the curb edge of the sidewalk several feet from the bank building. Only 8 ft by 6 ft on the outside and 6 ft by 4 ft on the inside, the booth would have been as hot as a dry kiln in summer and as cold as a frozen fish in winter without adequate air conditioning.

In order to conserve space, it was decided to install the air conditioning equipment in the bank basement about 30 ft from the booth. A hot water coil provides radiant heating while a steam coil and a humidifying section in the air unit conditions the incoming air. Outside air for ventilation is brought all the way from the alley end of the bank building in order not to compromise the safety features of the bank. The cooling load was estimated at 7400 Btu per hr and the heating load at 8800 Btu. Air circulation is 750 cfm.

The booth has a bulletproof window, and a sound system for communication with customers. An emergency steel exit door was erected in the rear of the structure.

This drive-in teller booth at the Amarillo National bank would be hot as a dry kiln in summer and cold as a frozen fish in winter without air conditioning

THE EDITOR'S PAGES

the necessity of making repairs, and higher condenser water temperatures prevail.

It, therefore, would appear desirable from the electrical viewpoint to shift the demand attributable to air conditioning from the electrical systems to the district steam systems, which with the advent of the new absorption air conditioning equipment can be satisfactorily and economically done, says the NDHA. From the steam utility viewpoint, such a move is quite desirable. The equipment of the companies, having been designed for heavy winter loads, has ample available capacity in the summer months. The principal additional expense to these companies is for more fuel and labor. The load factors of the steam utilities are improved.

Recognizing these trends, NDHA President David W. Loucks several months ago appointed an air conditioning committee headed by Robert D. Martin and including J. D. Johnson, H. A. Lawrence, H. L. Martin, S. S. Sanford, and W. S. Scott.

"QUOTE"

"The managements of our progressive companies are becoming more and more concerned with not only the physical welfare of their employees, but also with their plant and community relationships. They will spend any required amount of money to eliminate a health or explosion hazard when they know that such a hazard exists, and they will do the same when shown that by the elimination of the so-called nuisance dusts they can reduce spoilage of products, reduce wear of equipment and improve the employer-employee relationship.

"The day of the hot, dirty and dusty plant has ended, and both management and the engineer look at dust control as an absolute necessity. Usually a well designed and installed system will pay for itself in a comparatively short time, by the improved quality of work, by the savings in plant equipment maintenance, and by the workers good-will—when the recovered dust has a dollar value, there is a double return."—T. J. Barry, consultant on industrial dust control, at the ASME process industries division and Pittsburgh mechanical engineering conference.

RECORD NEW ORDERS FOR EQUIPMENT

Record new orders for air conditioning, heating and ventilating equipment during the quarter ended March 31 should in coming months largely offset first quarter declines in sales (shipments) of The Trane Co., according to Reuben N. Trane, president, who reported that consolidated net sales for the three months ended March 31 totaled $5,154,377, compared with $5,901,593 in 1949. The backlog of unfilled orders stood at $6,136,000 on March 31, a gain of $1,145,000 over the March 31, 1949, figure, he said.

New orders for the quarter were 18 percent above the same quarter of 1949, the year in which the company established record annual sales of $24,222,876. Shipments tend to follow new orders by four to eight months.

TEXTILE ENGINEERING BUILDING CONDITIONED

Textile research from now on will keep humming in a "cocoon of air" controlled within a fraction of a degree in the modern new Harrison Hightower textile engineering building at Georgia Institute of Technology, according to the Worthington Pump and Machinery Corp.

As the quality of finished textiles is dependent to a large degree upon the temperature and relative humidity in the various rooms in which the different processes are carried on, different steps require different temperatures. There are 14 separate air conditioning units, one in each room, in this new textile building to properly condition the laboratories. Two slightly smaller units serve the library, auditorium and main office.

A 150 ton centrifugal compressor will be used winter and summer, about 10 hr per day. It is designed to operate with a minimum of attention from operating personnel, being fully automatic with safety devices to cut off the compressor in case of emergency.

BETHESDA DEVELOPMENT TO HAVE FIVE 1200 HP MACHINES

A boiler plant with a steam capacity of 450,000 lb per hr will be erected at the Public Health Service's National Institute of Health Clinical Center development at Bethesda, Md., according to the U. S. General Services Administration.

The installation will also include five 1200 hp refrigeration machines which will deliver 10,500 gpm of 42 F water for air conditioning.

GSA expects to have the plans and specifications for the plant ready for contractors in time to receive bids for the construction contract during the summer. The structure will be about 100 ft high, 234 ft long and 110 ft wide. The 13 story clinical center, the principal building in the development, is presently under construction.

DR. WILLARD HONORED AT M.E. DEDICATION

Dr. Arthur C. Willard, president emeritus of the University of Illinois and head of the mechanical engineering department from 1920 to 1934, was honored in a surprise ceremony last month during the dedication of the new m.e. building by presentation of a bronze tablet from the National Warm Air Heating and Air Conditioning Association. The plaque will hang in the foyer of the new building.

The inscription is in recognition of Dr. Willard's preeminence in engineering education, research and administration, and his notable contributions to the science of engineering and the art of heating, ventilating and air conditioning.

The heating and ventilation of the new mechanical engineering building at the University of Illinois was described in an article by Professor J. R. Fellows in the May HPAC.

The Right Webster Trap

will save money

For maximum production from steam-using equipment or for faster, more efficient radiator heating, the right trap will save money. First step in picking the right trap is to pick a Webster Trap. But, get the right size – not any size – for best service.

No single trap can meet all trap requirements. If it's right for low pressure service on drips of mains or radiators, it may not be right for high pressure service on process steam-using equipment. That is why Webster makes a "family" of traps – each designed to give prompt, *continuous* condensate drainage in a particular application.

Webster Traps save steam. Hold steam in radiators and steam-using equipment until it has given up all of its useful heat. Give years of trouble-free service. Materials are selected for ability to withstand severe service.

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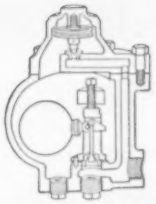
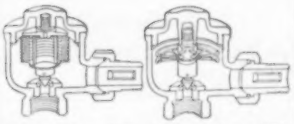
Webster HEATING

FIVE WEBSTER TRAPS IN 15 BODY MODELS

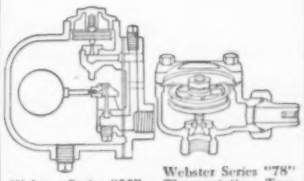


Webster Series "79" Float and Thermostatic Trap for pressures of 15 to 150 lbs.



Webster Series "5" Thermostatic Trap, bellows type, for low pressure vapor and vacuum heating. Up to 15 lbs. ½, ¾, 1" sizes.

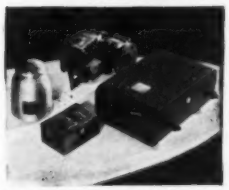
Webster Series "7" Thermostatic Trap, diaphragm type, for low pressure vapor and vacuum heating. Up to 15 lbs. ½, ¾, 1" sizes.



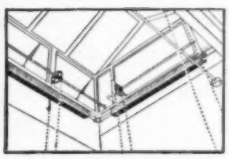
Webster Series "26" Heavy Duty Drip Trap for pressures up to 15 lbs.

Webster Series "78" Thermostatic Trap for process, 10 to 150 lbs. ⅜, ½, ¾ and 1" sizes.

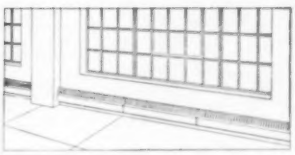
ENGINEERS . . . Check here for latest catalog data on these Webster Heating products:



☐ Bulletin B-900-4A describes Webster Electronic Moderator System. Tells how it works. Just four control elements—an Outdoor Thermostat, a Variator for manual control, a Pressure Control Cabinet, a Motorized Steam Valve.



☐ Bulletin B-1350 gives description, dimensions and ratings on Webster Type WI Extended Surface Radiation. For steam or hot water heating. Available with or without standard cover.



☐ Bulletin B-1351 describes the new Webster Walvector for steam or hot water heating. Non-ferrous convector with sturdy attractive enclosure. Particularly desirable for educational and institutional buildings, office buildings and other commercial structures.

☐ Bulletin B-705 describes Webster Radiator Valves, both spring-retained and bellows packless. For low pressure vapor and vacuum heating service.

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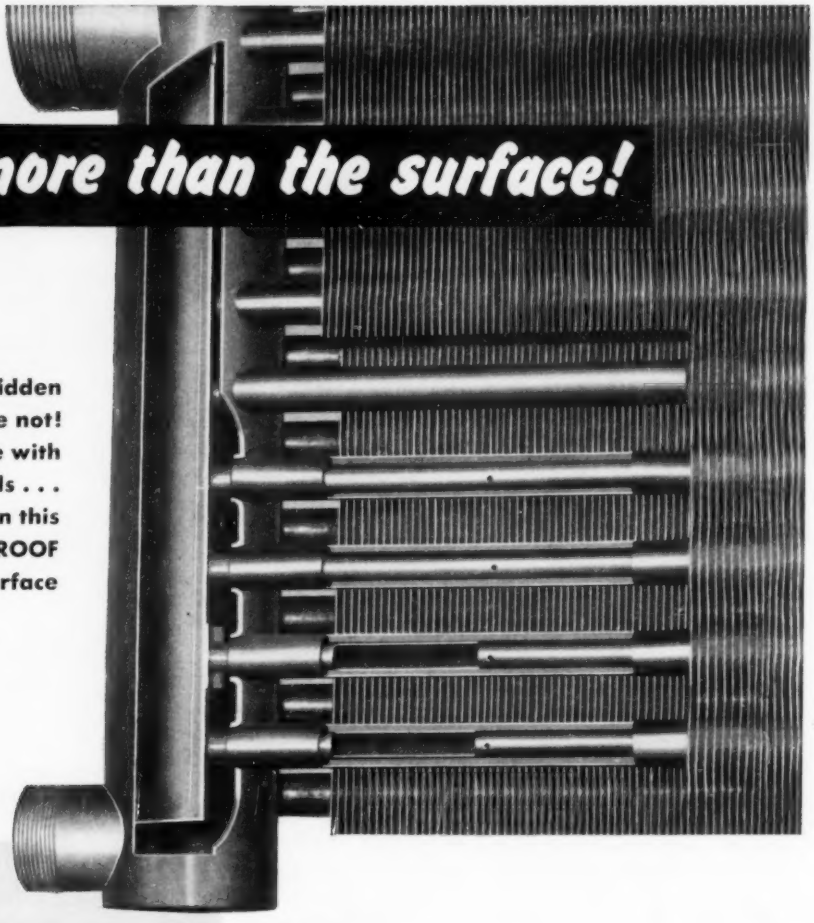

Surface is hidden but results are not! Don't gamble with inferior coils . . . Insist on this Nesbitt FREEZEPROOF Heating Surface

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When your system results are predicated on uniform discharge temperature from the heat transfer surface, you must KNOW that the surface you specify will DELIVER . . . So you must look beneath the surface for the best assurance there is that even small amounts of steam under modulated control will be distributed UNIFORMLY over the entire coil. You find it in the steam-distributing tubes of Nesbitt Series D Heating Surface . . . orificed tubes within the condensing tubes . . . an original Nesbitt application that has been tested and proved in thousands of installations. Would you like Publication 247?

WE BET you've got something to say about one of the articles published this month. An additional comment, or perhaps a question on some point? Or do you want to express your views on some other matter of interest to heating, piping and air conditioning engineers or contractors? We follow here the custom at engineering society meetings of allowing a period for discussion following presentation of a paper. You are invited to participate. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2.

AIRCRAFT CONDITIONING ENGINEERS NEED "SPONSOR"

THERE IS AN extensive group of aircraft engineers practicing air conditioning, scattered throughout the country, with no national or regional organization or publication for interchange of ideas or discussion. The balance of the aeronautical engineers are fairly well covered by technical societies, but the air conditioning, pressurization and anti-icing designers and engineers are "orphans." An outlet is needed for interchange of ideas, fellowship and recognition.

Aircraft air conditioning goes far beyond commercial air conditioning in most of its aspects. Air conditioning is no longer a luxury item in most commercial and military flying, but has become a necessity to protect personnel from extremes of temperatures far beyond the tolerance limits.

At high altitude, ambient temperatures of —100 F have been measured. At high speeds near sea level on a hot day, temperatures of approximately +250 F could be imposed upon the personnel. Since both of these extremes are not uncommonly encountered on the same flight, even within minutes of each other, the problems confronting the aircraft air conditioning engineer begin to take shape. When the problems of changes in pressure with altitude, icing conditions from sea level to 20,000 ft, the constant bugaboo of weight and space considerations are added, it is no wonder the man charged with the design (or choosing) of the necessary equipment feels he would like somewhere to talk it over, see how the other fellow has handled it, or get fresh ideas to handle his own job better.

There has been some attempt to get a group of local aircraft engineers interested in these subjects together under an informal aircraft air conditioning forum. Meetings, however, are very sporadic, only three having been arranged in the last year, although meetings each month were hoped for. The need for sponsorship is apparent.

The following list of subjects are those I am most interested in at the moment. Probably a similar (but different) list could be prepared by each of the various engineers charged with the design of the air conditioning systems in each of the aircraft companies throughout the country.

1) Adoption of standard method of calculating cabin dumping orifice (dump valve size), or given valve size, time required to dump. Is process isothermal or isentropic?

2) Are we using, in our present calculations, the proper criteria for defogging of transparent areas at altitude?

3) Discussion of testing that has been conducted on hoses (or hose and clamp combinations) for connection of high temperature, high pressure ducts. This to be with view to eliminate duplication of investigation and testing, and pooling of information.

4) Discussion of thermal coatings for heating and/or anti-icing.

5) Discussion of cooling for high speed aircraft (over 700 mph). Required performance of expansion turbines. Determination of cabin UA values for high speeds.

6) Discussion of an accepted rapid method of determining duct sizes in conditions involving compressible flows.

7) Effectiveness of defogging slots less than ¼ in. thick, with various initial velocities.

I hope you will find it within the scope of your magazine to give more space to our problems, and that the American Society of Heating and Ventilating Engineers will set up a section covering the activities of the aeronautical group.—G. R. ALDRICH.

DEFLECTION IN PIPE LINES

I AM PLEASED to comment on the alignment chart for stress and deflection in horizontal pipe lines, by L. E. Partch, published as the Data Sheet in the May HPAC. Mr. Partch's chart is designed to calculate bending stress and deflection in a pipe due to its own weight. Having published a similar chart in my article, How to Space Pipe Supports, which appeared in HPAC, I am naturally very much interested in this subject.

In solving, on my chart, the example given by Mr. Partch, I find perfect agreement between the two charts. My value of 2.29 in. for pitch in a fixed span corresponds to Mr. Partch's value of 1.85 in. Similarly, for free spans, the pitch is calculated to be 5.2 in., which corresponds to Mr. Partch's value of 4 in.

If one remembers that my formulas for calculating slope carry a factor of safety of two to allow for possible misalignment, and bearing in mind that the rule used by Mr. Partch of making the pitch equal to five times the deflection is entirely empirical, one is satisfied that the agreement between the two charts is very good.

In my article, I instructed the calculator to ignore the weight of the water in the pipe when calculating slope to drain; because, as the water is drained, the pipe will spring back to its empty position. In the above calculation, I assumed the pipe full of water in order to

make it comparable to Mr. Partch's calculation.

I am convinced that the rule of making the pitch in one span equal to five times the deflection is a very satisfactory procedure. However, it appears to me to be no simpler to apply than the correct calculated slope as obtained from my charts. When one is laying out a long line on sloping ground, one can measure the percent slope of the ground and enter my chart with this value of slope and thus obtain a pole spacing without resorting to cut and try methods.

I am disappointed that Mr. Partch calculates a safe span of 59.5 ft on his chart and then suggests arbitrarily cutting it back to 25 ft. Such conservatism can sometimes be very expensive. The allowable stresses given in the Code for Pressure Piping include a factor of safety and there is no need to increase this. One must, however, refine his calculation to include wind loading and thermal expansion stresses if one is going to space supports at the calculated limit.

Mr. Partch states that the assumption of fixed supports must be used with discretion: "This last figure must be used with discretion and is true only when the supports are perfectly lined up for equal loads." Obviously, supports are never perfectly lined up. This limitation should not be taken too seriously. The piping code, paragraph 620 g, allows higher stresses when yielding will cause relaxation of the stress. Misalignment stresses are relaxed on yielding of the material in the pipe. One case has been reported where a very high wind tipped over several supports in a 550 psi steam line. No interruption in service occurred and no leaks developed even with the pipe lying on the ground. Obviously there must have been many places in the line that were stressed beyond the yield point, as it fell to the ground.

Mr. Partch uses the code method of calculating the allowable stress due to bending, except that he has ignored thermal expansion. This is permissible in some cases. Actually, the code should be revised because it ignores some of the effects of high wind loading. High wind loading will combine with thermal expansion bending stress and produce axial compression in some fibers which may over-ride the axial tension due to pressure in some cases. When this happens, the resultant axial compression will, according to the maximum shear theory, add directly to the hoop tension. This possibility is ignored in the piping code. In my article, I have tried to calculate the true equivalent stress. The method in the piping code does not appear to be applicable in all cases, i.e. where the bending stress dominates the axial tension due to pressure.

Mr. Partch also suggests closer spacing of free supports, "for the reason that a support may accidentally drop its load." It would seem impractical to try to design the piping to be safe even after failure of an important supporting member.

It is believed that the alignment chart prepared by Mr. Partch is correct as drawn, but some of the recommendations implied in the article, though consistent with the practice in many design offices, appear to me to be too conservative.—THEODORE E. BRIDGE.

REAL CONTRIBUTION TO AIR CONDITIONING

IN HIS ARTICLE, Temperature Dominates Mankind, in the May HPAC, Dr. Clarence A. Mills has made a real contribution to the air conditioning industry by giving actual scientific data to prove the harmful effects of sustained uncomfortably high temperatures. Worth noting is the fact that this is no "Sunday supplement" type of science. These are the considered statements of a distinguished scientist who has spent a lifetime on this subject.

An employer, who hires people to think, will have to also do a little thinking himself when he realizes that the ability to think can be reduced as much as 40 percent when temperatures are excessive. Many offices today, due to increased lighting and occupancy, provide an indoor tropical climate even when the outdoors is quite comfortable.

The employer who hires people to be aggressive and industrious must realize what it is costing him when his work force, through inability to loose bodily heat fast enough, gets into a lethargic state of mind, the "let George do it attitude" mentioned by Dr. Mills.—H. E. WHEELER, president, Air Comfort Corp.

STEAM ABSORPTION UNITS FOR AIR CONDITIONING

H. G. GREGERSON'S article in the May HPAC describing the steam absorption refrigeration installation for air conditioning a building in Dallas is a fine analysis of the problem. The district heating industry has had its attention on this type of equipment for some time. There are several successful installations throughout the country and apparently there are many more to follow.

It is important to point out that with the refrigeration installation on the roof of a building, the pumping costs for chilled water would be reduced over those for a similar unit placed in the basement.

Consideration should be given with the absorption type of machine to the installation of cooling towers, since the water consumption is considerably above the other types.

In one small Detroit department store, the steam consumption was carefully recorded for a 12 month period before and after the installation of an absorption type air conditioning machine. More than 40 percent of the steam used annually in the building was for air conditioning.—G. D. WINANS, assistant superintendent of central heating, The Detroit Edison Co.

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● Revere Red-Brass Pipe has been used for many years in residential, industrial, commercial, institutional and municipal construction. It is highly resistant to corrosion and can be used where relatively high velocities exist.

Revere Red-Brass Pipe is 85% copper. It is made in standard pipe sizes for use with threaded fittings. In new construction, this pipe has kept the average cost for maintenance and repair surprisingly low. In existing construction, this pipe should be considered where pipe of other material has proved unsatisfactory.

Revere also provides Copper Water Tube for use with solder or compression fittings; type B Copper Tube, for installations requiring outside diameters of SPS pipe and brazed fittings; and Copper Pipe for use with threaded fittings. Every length of Revere pipe and tube is marked with the name Revere. Look for this mark as your assurance of top quality.

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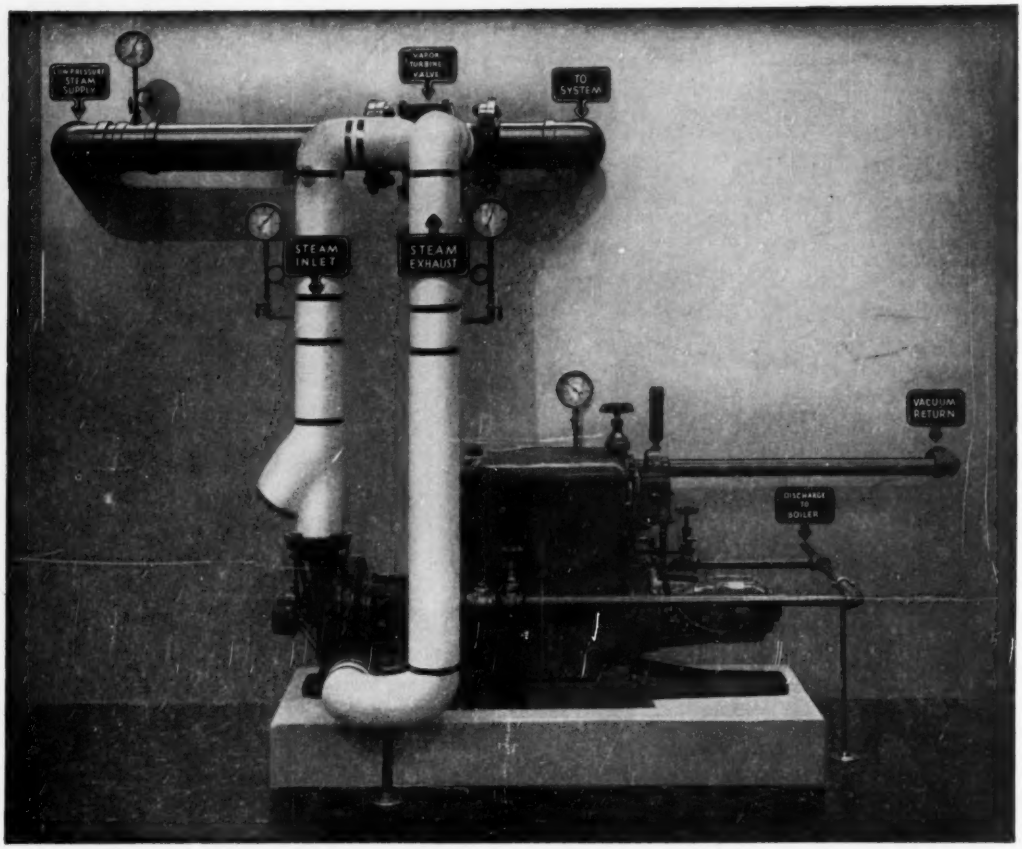
Interrupted Electric Service will not stop this NASH Heating Pump



In Hospitals, Greenhouses, Schools, Public Buildings, Theatres, wherever heating systems must not fail, install the Nash Vapor Turbine, for it is independent of electric current failure, and continues to operate as long as there is steam in the system.

This is because the prime motive power of this economical pump is a special steam turbine, controlled by a unique "Vapor Turbine Valve", which automatically bypasses from the heating main a small portion of steam, the exact amount necessary to develop the power needed to remove the condensate and maintain the required vacuum on the system. Even this small amount is passed immediately back to the mains, and goes on to the system with little heat loss. This pump operates on any system, high or low pressure.

The Vapor Turbine is a most economical pump, for the elimination of electric current does away with current cost, the largest single item in the operation of an ordinary return line heating pump. Bulletin on request.

THE NASH ENGINEERING COMPANY
205-A WILSON ROAD, SOUTH NORWALK, CONNECTICUT, U. S. A.

The Grosvenor House apartment building as it will appear when completed this fall. The panel heating system will also provide panel cooling by means of city water in summertime (photo courtesy Earl W. Morrison, architect)

Big Grosvenor House Apartment Has Panel Heating and Cooling

ERWIN L. WEBER, consulting engineer, describes the 18 story Grosvenor House apartment building under construction in Seattle—believed to be the largest FHA insured mortgage apartment house and to have the largest panel heating and cooling installation in the U. S. The coils for the heating were shop fabricated on practically a mass production basis, leading to important economies, and the cost of labor for installation was extremely low, according to Mr. Weber

GROSVENOR HOUSE—now being completed by Harfst & Henson for the Kellerblock Corp. of Seattle—will be the largest FHA insured mortgage apartment house under one roof. It will be 18 stories high, with 22 apartments on each typical floor, a total of 370 apartments facing Wall St., and a three story garage with roof garden facing Vine St. There will be 12 stores on 5th Ave. and a restaurant and eight stores on 6th Ave.

The boiler plant comprises two steel hot water boilers, each of 10,200,000 Btu rating, arranged for rear oil firing and readily convertible to front coal firing. The oil storage tank is of 8500 bbl capacity. Coal and ash bunkers are provided.

The hot water tank has 3360 gal capacity and has a copper heating element with 600 sq ft of surface.

Three Converters for Heating System

There are three converters for the heating system, as follows:

L—for low temperature floor coils, with 100 sq ft of heating surface.

S—for south exposure apartments, with 200 sq ft surface.

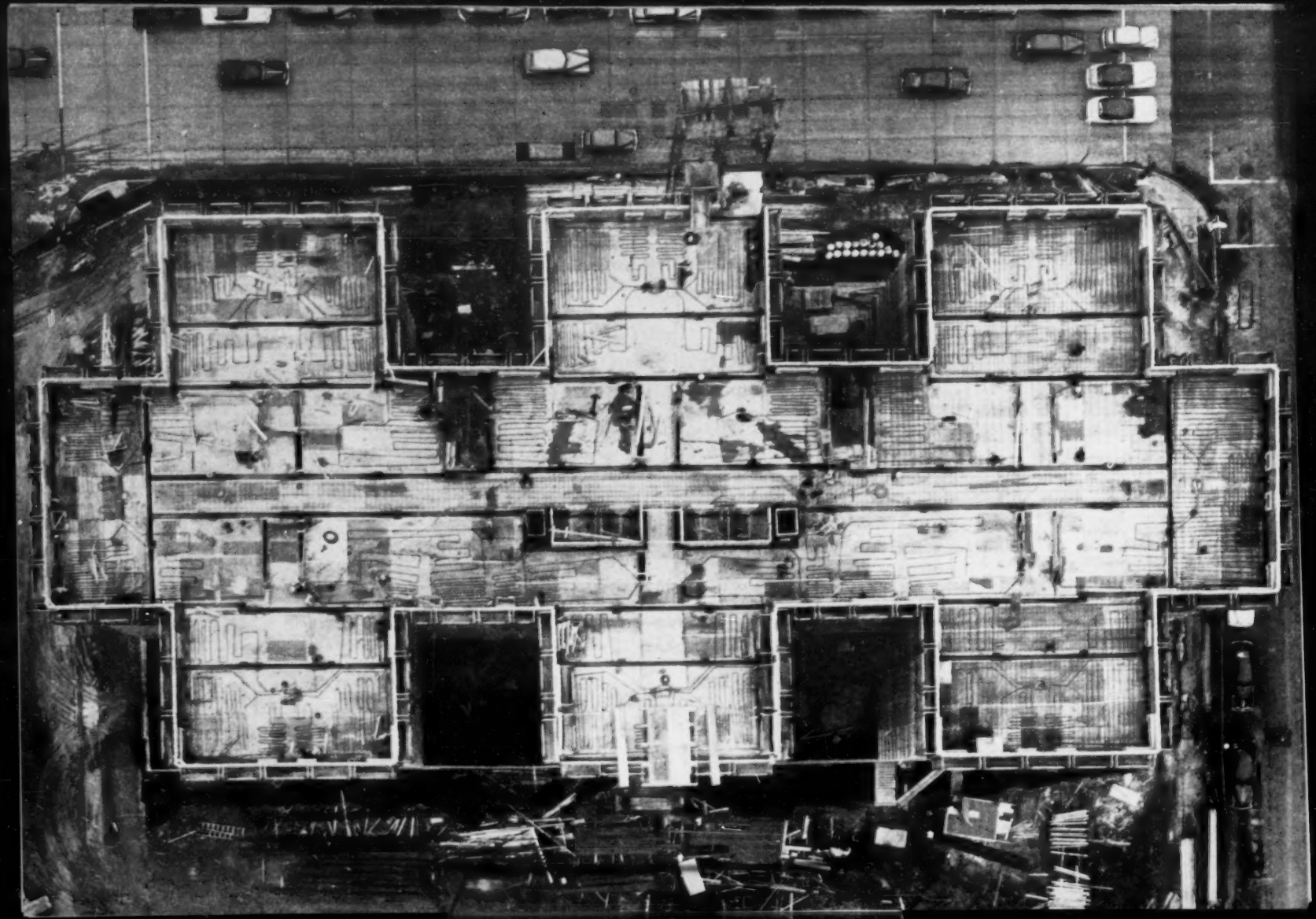
N—for north exposure apartments, with 400 sq ft surface.

Duplicate motor driven centrifugal pumps are provided for the boilers, domestic hot water circulation, floor coils, north coils and south coils.

The "environditioning system" has about 35 miles of steel pipe imbedded in the concrete ceiling slabs and first floor ground slab of the building, making it the largest panel heating and cooling system in the United States. A concealed shutoff valve is provided for each room. The heating and cooling system is completely concealed.

The thermostatic control systems are operated by outdoor thermostats which vary the water temperature according to outdoor temperatures. In the floor heating coil system, the water temperature will vary from 75 to 105 F with outdoor temperatures from 65 to 20 F.

In the north and south ceiling coil systems, the water temperature will vary from 75 to 125 F with outdoor temperatures from 65 to 20 F. The water temperature will be increased ½ deg for each mile of wind



Aerial view *(opposite)* of the 17th floor of Grosvenor House taken at an altitude of 600 ft and showing the radiant heating coils. The 18 story building is 230 ft long by 100 ft wide, and there is a three story garage of the same dimensions in the rear (photo courtesy Bethlehem Pacific Coast Steel Corp.)

velocity in excess of 15 mph.

The wind adjusting control is a combination of a weathervane with typical rotating arrow and a standard static pressure control. The static pressure control sensing the pressure as exerted by the velocity of the wind, readjusts the thermostat in the flow line to the building and through increments of control air pressure readjusts the water temperature controller above its setting as made by the temperature outside controller. The increment in water temperature in proportion to wind velocity is accomplished through the proper setting of the static pressure regulator.

Solar Heat Control for South System

The south system will also be provided with a solar intensity mechanism which will immediately shut off the heating on the south apartments when the sunshine gets to a predetermined intensity, to counteract the solar heating effect therefrom.

The solar compensator is an insulated enclosure with a window in one side and is mounted so that its window is parallel to the windows in the zone it serves. The temperature inside of the solar compensator is equal to the outdoor temperature plus a temperature rise which is proportional to the solar energy received. The setting of this instrument is such that at a certain temperature as indicated by the combination of outdoor temperature and solar energy all heat addition to that zone will be immediately stopped.

All pumps are controlled by clocks to turn the various systems on and off at predetermined times.

Exhaust registers with boots are provided for each bathroom and kitchen, and are connected with a 36,000 cfm exhaust fan in the penthouse. Individual exhaust fans are provided for the garage, transformer vault and restaurant.

The heating coils will be used for panel cooling in the summer by circulating city water.

Cooling water will be run through the coils and pass out of the overflow line to be discharged through spray heads on the roof to counteract the solar radiation to the roof and keep the attic space and top (18th) floor cool.

Another unique feature of the building is that the cold water system is arranged for continuous circulation. This avoids the tepid cold water often found in apartments.

Each apartment has a built-in sink, wall outlet water closet with flush valve, lavatory and bathtub with shower and shower curtain. Each apartment is provided with electric range and refrigerator, soft lighting fixtures, and with door chimes. There are four electric elevators. All hall lights are wired on continuous three-way circuits. Each apartment is metered.

All flow and return risers were run in the interior plumbing stack spaces, thus eliminating the cost of additional chases and furred in spaces in the outside walls, and materially decreasing the number of risers.

System Economical to Install

The heating system showed many remarkable economies in its installation. The cost of the coils was under 11 cents per lineal foot, completely bent, welded, tested and delivered at the site. About 5 lineal feet of coil is the equivalent of 1 sq ft of equivalent direct radiation.

The riser system installation was very economical because of the comparatively few risers which were located in the inside plumbing shafts instead of at the outside walls. These shafts also provide an excellent place to install and conceal expansion loops in the risers.

From the downfeed flow risers, the flow branch for each apartment is taken off and then extends around near the outside wall. The coils for the individual rooms are taken off and a return line for each room is run to the kitchen, where it is provided with a radiator valve at the ceiling of the broom closet and connected through a short header to the return risers.

Only 20 coil patterns were required for the entire apartment heating installation. The coils, flow mains, return mains and headers were shop fabricated on practically a mass production basis. They were then assembled on the form deck, all connections field welded in place, and tested with water at 125 psi.

The cost of labor for installation was extremely low. The heating contractor was allowed only one day per floor to install and field weld the coils. Six welders performed this work in less than a day, making the labor per floor six man-days.

Aerial Photo Shows Coil Installation

The accompanying aerial photograph was taken at 11:00 a.m. The coils were first welded and tested at the left end of the building. During this time the reinforcing steel and conduits were placed in the corridors and halls. It will be noted that at 11:00 a.m., reinforcing steel and conduits are already in place in the three wings at the left. One welding crew is working in the lower center wing and another in the right top wing. They were finished at 2:30 p.m. On the following day, all reinforcing steel and conduits were in place and concrete pouring was begun at the left end of the building.

Solves Temporary Heat Problem

Radiant heating quite effectively solves the temporary problem of heating during construction. In the recently completed Yakima municipal airport, the coils were filled with brine last winter when the outdoor temperature was 10 F and the interior finishing of the building was completed during the most severe winter experienced in that region.

The cost of the installation at Grosvenor House compares very favorably with other methods of heating such structures, in the author's experience.

The building was designed by Earl W. Morrison, architect. W. H. Witt Co. were the structural engineers. The electrical, mechanical and sanitary equipment was designed by the author. The heating, ventilating, sprinkler and plumbing systems are being installed by the University Plumbing and Heating Co.

Weldability of

PIPING MATERIALS

WELDABILITY is the term used to generally indicate the relative ease—or difficulty—with which a material can be welded. As characteristics appear which adversely affect welding, greater precautions must of course be exercised. The characteristics of both ferrous and nonferrous piping materials which affect their welding are outlined here

THE TERM weldability is used to generally indicate the relative ease, or difficulty, with which a material can be welded. As characteristics appear which adversely affect weldability, greater precautions must be exercised.

Ferrous Piping

In the welding of ferrous piping, the following characteristics should be considered:

1) Any strong tendency of the base metal to crack during the welding operation or while cooling after welding.

2) Any major change in mechanical properties due to the welding.

3) Any marked change in the metallurgical structure of the base metal as a result of the welding operation.

4) Changes in chemical composition by volatilization or reaction with air.

5) Formation of refractory coating, making special fluxes necessary.

Carbon steel piping materials in the carbon ranges and thicknesses usually encountered are free from the tendency to crack during or after welding, nor do any significant changes take place in their mechanical properties or metallurgical structure. When the component parts have a thickness of ¾ in. or greater, however, there may be some difficulty in obtaining welds free from cracks due to the mass of metal and the greater rigidity of the parts. For this reason, as will be shown below, preheating and stress relief are usually required when wall thicknesses of this order are involved.

Underbead cracking is a factor of hardenability of the steel, which is determined by its chemical composition. In Table Q-5 of Section IX of the American Society of Mechanical Engineers Boiler Code, some measure of the effect of chemical composition on weldability is found. The simplest carbon steels are grouped in the first section (P1) of this table. Their carbon contents are limited to 0.55 — [(Mn + Si)/4], where Mn and Si are, respectively, the percentages of manganese and silicon. The third section (P3) of the table contains another group of steels with higher maximum contents of carbon and manganese, and with carbon limited to 0.65 — [(Mn + Si)/4].

A parenthetical note states that experience has indicated the advisability of preheating up to 350 F when welding materials in this group. No comparable rules or suggestions are found in other portions of Table Q-5 dealing with alloy steels. However, Pars. P-108 and P-112 of Section I of the Boiler Code require that welded joints be stress relieved by uniformly heating to at least 1100 F, and up to 1200 F (or higher if this can be done without distortion) for all materials. Different temperatures may be used to obtain proper stress relief as required by the characteristics of the metal. The only exceptions to this requirement are that carbon steel and carbon molybdenum steel (when the latter contains not more than 0.20 percent C) need not be stress relieved when the wall thickness is ⅜ in. or less.

On the other hand, the following specific requirements regarding preheat and stress relief are contained in Pars. 627 and 628 of the American Standard Code for Pressure Piping:

Preheating to 400 F is required for welded joints

a) in carbon steels containing more than 0.35 percent carbon when the wall thickness is ½ in. or greater (this combination is rarely found in welded pipe systems);

b) for all thicknesses of carbon-molybdenum steel piping.

Stress Relief at 1100 to 1250 F is required (except where heat treatment for reasons other than stress relief requires a higher temperature)

a) for all carbon steels ¾ in. thick or thicker;

b) for all carbon steels containing in excess of 0.35 percent carbon regardless of thickness;

c) for carbon-molybdenum steels when the wall thickness is ½ in. or greater.

Some carbon molybdenum steel pipe has been found to be susceptible to *graphitization*, the precipitation of free carbon in the form of graphite nodules or flakes, when subjected to prolonged service at temperatures of the order of 900 to 950 F. The reasons for varying degrees of susceptibility are not yet clearly understood, but it is believed that deoxidation practice, forming, subsequent heat treatment and welding influence the extent of the occurrence of graphitization. Its most serious form is a segregation of graphite particles at the extremity of the area affected by the heat of welding. It is now generally believed that either a normalizing treatment consisting of heating at 1725 F for 2 hr, followed by slow

From the Welding Handbook, third edition, published by the American Welding Society, by special permission. The chapter on industrial piping of this handbook was prepared by a committee consisting of D. H. Corey, The Detroit Edison Co., chairman; A. N. Kugler Air Reduction Sales Co.; J. D. Mattimore Tube Turns, Inc.; J. Hall Taylor, Taylor Forge & Pipe Works; H. Weisberg, Public Service Electric and Gas Co.; and C. C. Zimmerman, Benjamin F. Shaw Co.

cooling (300 F per hr) to 800 F, or stress relief at 1300 F for 4 hr, will retard, if not prevent, the serious type of graphitization. It is further believed that the normalizing treatment described above will partially, though not completely, restore the mechanical properties, particularly the ductility, of welded joints in which segregation of graphite has begun but has not progressed to a serious degree. (For more detailed information consult recent volumes of the ASME Transactions.) It is believed that carbon molybdenum steel pipe will not graphitize to any serious extent at service temperatures of 850 F or lower.

Alloy steels (for which no specific rules exist), with the exception of the austenitic stainless steels, almost invariably require preheat and stress relief in order to avoid cracking during the welding operation or subsequently due to the combined effect of their air hardening properties and residual welding stresses.

The need for preheating, and even more important, for postheat treatment is particularly evident in the case of the chromium bearing steels of the medium and high alloy groups, with the possible exception of the 5 percent chromium grade when stabilized by titanium or columbium addition. See Chapter 30, Chromium Irons and Steels, American Welding Society Welding Handbook. (These stabilizers also have the effect of materially reducing the air hardening tendency of this steel.)

Steels having a chromium content ranging from 4 to 14 percent with little or no nickel, are decidedly air hardening and, in addition, have suppressed transformation points (400 to 700 F) when cooled from welding heat. This means that their greatest shrinkage, when cooling, takes place at a temperature when the metal is no longer sufficiently plastic to absorb such shrinkage without extremely high residual stresses being created. Of all the steels used in welded piping these are probably the most susceptible to cracking during cooling. Ideally, welded joints in these materials should be maintained uniformly at a temperature above 700 F during the welding operation. Immediately after completion of the weld, the entire assembly should be put in an annealing furnace, the temperature raised to 1550 to 1650 F and allowed to cool slowly to below 400 F. If the higher mechanical properties obtainable by normalizing are desired, the material may be withdrawn from the furnace after uniformly attaining a temperature of at least 1550 F and allowed to cool slowly in still air. If furnace heat treatment is not practical, local stress relief at a temperature of 1300 to 1400 F may be used. It is important, when such local stress relief is used, that the heated area be slowly cooled to at least 400 F. Local stress relief, if performed at proper temperatures, decreases the hardness of the weld zones, improves the ductility and relieves the stress. Present available evidence indicates that local stress relief will not result in increased hardness at the edges of the heated zone.

Straight chromium steels containing more than 14 percent chromium fall into two distinct classes, those containing 14 to 18 percent chromium and those containing 18 to 30 percent chromium. Both are known as ferritic types, being completely ferritic at all temperatures. When welded they are subject to excessive grain growth, resulting in brittleness and reduced impact strength at room temperature. Refinement of grain structure cannot be effected by heat treatment, but stress relief does improve ductility and removes shrinkage stresses.

Preheating at 200 to 400 F is desirable for 14 to 18 percent chromium steels. Stress relief should be performed at 1400 to 1450 F followed by slow cooling to 1000 F. This need not follow immediately after welding.

Steels containing 18 to 30 percent chromium are generally not preheated since this seems to increase the extent of the area in which grain growth occurs. After welding they should be heated to 1600 to 1650 F for not less than 1 hr per in. of thickness, and then cooled rapidly to obtain maximum ductility. When welded with 25-12 or 25-20 chromium-nickel filler metal, which is frequently employed in welding high chromium steels in an effort to obtain ductile welds, stress relief at 1450 to 1500 F gives somewhat better results.

Stress relief of 5 and 9 percent nickel steels is carried out at temperatures ranging from 1050 to 1100 F in order to avoid the lower critical temperature of these metals, which have a transformation point at 1200 F or slightly higher.

The mechanical properties of the chromium-nickel steels used in piping are not affected by heat treatment. However, those which do not contain stabilizing elements, such as columbium, are subject to carbide precipitation as a result of heating through the range of 800 to 1600 F which occurs during welding. Since heat treatment of piping assemblies to put the carbides back in solution is difficult and expensive, stabilized steels are usually employed when carbide precipitation would result in decreased life of the material. Nevertheless, when stainless steels are to be used for high temperature service, even with stabilizing elements, it is common practice to employ a stabilizing heat treatment consisting of a long-time soaking at 1550 to 1600 F to disperse the carbides. There has been a limited use of very low carbon (0.03 percent max) stainless steel either to minimize carbide precipitation in the unstabilized steels or to reduce the amount of columbium required for stabilization.

Nonferrous Materials

Whereas the weldability characteristics of ferrous piping materials are related primarily to their tendency to crack during the welding operation or during the subsequent cooling period, and to a lesser but highly important degree to their state of internal stress as a result of welding, neither of these characteristics is usually of major importance with nonferrous materials. In general, nonferrous metals, unlike some steels, do not tend to harden on cooling in air from the welding temperature, nor do they have suppressed transformations at temperatures below the plastic range, accompanied by appreciable volumetric changes. Thus, even though the ductility of the deposited metal is lower than the base metal, the danger of cracking is usually remote and the residual stress condition not sufficient to warrant concern over possible stress-corrosion effects. Again, in none of the nonferrous piping materials is there any comparable condition to that caused by the welding heat in unstabilized austenitic stainless steels which might bring

about carbide precipitation. Hence, there is usually no necessity for subsequent stress relief or other heat treatment after welding, except such as may be required by the ASME Boiler Code.

Copper and Copper Alloys (see Chapter 34, AWS Welding Handbook)—The chemical composition, high heat conductivity and high fluidity, when molten, of copper and copper alloys have considerable bearing on their weldability. Oxygen-bearing, electrolytic or tough-pitch copper is susceptible to oxide embrittlement when welded or heated above 1292 F in an atmosphere carrying hydrogen, hence it is not usually recommended for arc and gas welding. It can, however, be readily soft soldered and can be brazed provided a silver brazing alloy having a flow point less than 1292 F is used and the brazing temperature is carefully controlled. Deoxidized copper, or oxygen-free copper, on the other hand, can be satisfactorily gas welded, soldered or brazed in any position. Owing to the high fluidity of molten deoxidized copper, arc and gas welds must be made with suitable backing rings. All-position welding by oxyacetylene or inert gas, metal arc welding is possible, but quite difficult. Since piping installations involve all-position welding, soldering or brazing are the processes commonly used. Because of the high heat conductivity of copper, it is usually necessary to preheat when welding large diameter or unusually heavy pipe. Deoxidized or oxygen-free copper pipe and tubing have been standardized. Oxygen-bearing electrolytic or tough-pitch copper seamless tubes are available only on special order and their use is generally discouraged.

Oxyacetylene welding of red brass and yellow brass can be satisfactorily accomplished in all positions with suitable backing rings. Shielded metal arc, carbon arc and inert gas metal arc welding are not usually employed as the high heat intensity of the arc causes vaporization of the zinc content in the metal and sweating out and oxidation of any lead that may be present. All-position welding of brass is possible using the oxyacetylene process. However, soldering or brazing are more generally employed. When welding is attempted, preheating of large diameter and heavy wall pipe is usually necessary. Because of adverse experience encountered with dezincification of yellow brass pipe and tubing, red brass has been generally used and yellow brass pipe and tubing are usually available only on special order.

Copper-silicon alloys have a heat conductivity approaching that of steel, and are readily controllable when molten due to a glasslike slag which forms on the surface of the molten pool. They do not have any chemical constituents which easily vaporize, hence they are more easily welded than any of the other copper alloys used in piping. The copper-silicon alloys can be welded by means of the oxyacetylene, inert gas metal arc and carbon arc processes. Shielded metal arc welding can also be used if suitable covered electrodes are available. Welds can be readily made in the flat and vertical positions; the overhead position is more difficult. Backing rings are not required although they are sometimes used. Of the processes mentioned, inert gas metal arc welding is the most popular because of the soundness and ductility of the welds obtained.

The principal copper-nickel alloy used for pipe and tubing is that known as 70–30, in which the numbers indicate the proportions of copper and nickel, respectively. Other cupro-nickels with lower nickel proportions are available. Cupro nickel, 70–30, offers superior resistance to the corrosive action of sea water, hence finds its widest use for water pipe and condenser tubes on ships. The most suitable process for welding this alloy is shielded metal arc welding. Inert gas metal arc welding and oxyacetylene welding, using a special silicon-bearing welding rod have also been used successfully. While 70–30 cupro-nickel is one of the most readily weldable copper base alloys, cracking due to hot shortness may at times be encountered. Brazing with silver alloys is also utilized extensively. However, care must be exercised to select a brazing alloy with a low flow point to prevent intergranular penetration, which might occur at high temperatures if the base metal happens to contain residual stresses set up during forming, etc.

Nickel and Nickel Alloys (see Chapter 35, AWS Welding Handbook).—This group of metals behaves similarly to mild carbon steel and can be welded by the same processes that are used for steel, although sometimes with slight modification of the procedures and techniques. Pure nickel has a narrow solidification range and as a result has a tendency to trap gas. The weld metal of nickel and most of its alloys is very sluggish on deposition. In all cases it is necessary to remove any surface oxide, preferably followed by washing with carbon tetrachloride to obtain freedom from porosity. Satisfactory welding of cast monel to wrought monel or cast monel to wrought steel is very difficult, as cracking will often occur in the cast parts; hence, the welding of cast monel to wrought material should be avoided when possible.

Aluminum and Aluminum Alloys (see Chapter 32, AWS Welding Handbook).—This group of metals, from the standpoint of weldability, is characterized chiefly by their low melting points (1075 to 1210 F), high heat conductivity and fluidity when molten. Thus, training and experience are necessary before production welding should be attempted. While aluminum and aluminum alloys can be joined by any of the commercial welding and brazing processes, those most commonly employed are the inert gas metal arc, oxyhydrogen and oxyacetylene processes. Aluminum and aluminum alloy piping and tubing are generally supplied in either a work hardened or precipitation hardened condition (obtained by cold working or heat treatment depending upon the alloy) which gives the material greater strength. The welding operation softens the metal for a distance of one to five times the pipe thickness on either side of the weld and materially reduces the tensile strength in this zone.

It is impractical to restore the original strength of fabricated assemblies by subsequent cold work or heat treatment. In spite of this, it is desirable to use cold worked or heat treated pipe to obtain increased resistance to denting or bending in handling and erecting. Additionally, there are indications that the bursting strength of pipe joined by circumferential butt welds is not reduced from that of unwelded pipe to the extent that might be expected based on the actual local strength of the joint

after welding. Commercially pure aluminum and aluminum alloyed with 5 percent silicon are the only filler metals presently employed. In the case of the latter, lower ductility of the deposited metal compared with that of the wrought base metal can be expected. Because of the high fluidity of this group of metals, backing rings should be employed wherever possible.

Lead and Lead Alloys (see Chapter 36, AWS Welding Handbook).—The satisfactory welding (erroneously called burning) of these metals requires a high degree of manual skill which is acquired only after long practice. This is due to their low melting temperatures and high fluidity.

The oxyhydrogen process is in most common use. The oxyacetylene process is not generally used for wall thicknesses below ½ in., as this mixture of gases develops too high a temperature for welding thin sections. Air-hydrogen, air-acetylene, oxy-city gas, etc., may be used but should be avoided if oxyhydrogen is available.

Provision for adequate ventilation should be made where lead is to be welded in closely confined quarters.

NEW YORK BUILDINGS INSTALL SNOW MELTING

AFTER THE "big snow of '47" it was inevitable that serious consideration would be given to the problem of snow removal when planning any new structure in New York City. At 100 Park Ave., in the shadow of Grand Central, work has been completed on a sidewalk snow melting system employing the piping principles of radiant heating. Coils or

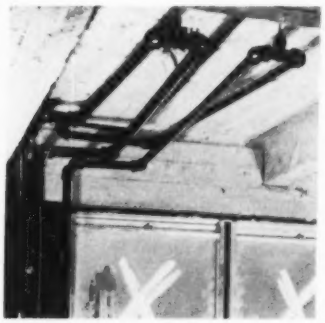
A simple clamping device holds the pipe together for welding the snow melting system at 100 Park Ave.

panels of steel pipe were embedded in the concrete sidewalks to form a heating system in which a mixture of antifreeze and water heated by steam in a closed system will warm the concrete and melt falling snow on contact. There are 10,000 sq ft of sidewalks on the three sides of the building. Nine thousand feet of steel pipe is used in the coils.

It is a grid system designed to melt 1 in. per hr of snow and consists of 1¼ in. headers and ¾ in. pipe legs with 12 in. spacing. A structural concrete slab was first laid. Two inches of foam glass insulation was laid on this structural slab and then a vapor seal of tar paper mopped with tar was applied. On top of this was laid a 4½ in. slab in which the pipe was embedded, the coils being about 2½ in. below the surface.

The 36 story office building will be 100 percent air conditioned. Heating and cooling units are located under the exterior windows. In each unit, conditioned air brought in through ducts, and room air, is passed over water coils. During cold weather, the water in the pipes will have a temperature of approximately 140 deg and in warm weather, the water temperature will average 50 deg.

Being installed by Kerby-Saunders, Inc., the system uses 110,000 ft of steel pipe. Risers through which the water is circulated ascend inside the peripheral



Expansion joints such as these at the 31st floor of 100 Park Ave. permit the steel pipe risers to rise or lower several inches when the air conditioning system changes from heating to cooling (photo courtesy Jones & Laughlin Steel Corp.)

walls. Some of them are columns of steel as much as 460 ft high.

The building was designed by Kahn and Jacobs, architects. George A. Fuller Co. is the general contractor. Jaros, Baum & Bolles are the consulting engineers.

A snow melting system serving 12,000 sq ft of sidewalk area around the new 25 story Mutual Life building at Broadway and 55th St., New York, involves the use of approximately 14,000 linear feet of steel piping from ¾ in. to 3 in. in size.

The piping system required more than 2000 welded joints, and was tested to 200 psi. It is installed approximately 4 to 5 in. below the finished surface of the sidewalk.

A system of distribution piping is located in the basement to connect the sidewalk coils with the heat exchanger and pumping equipment so as to permit circulation of a mixture of water and glycol antifreeze. The system will require in excess of 1000 gal of antifreeze so as to provide a 40 percent antifreeze-60 percent water mixture, suitable for operation to temperatures as low as minus 12 F. The mixture will be heated to approximately 140 F in steam heat exchangers, using steam from the New York Steam Corp. It is planned to start the operation of the system before snow actually falls.

The heating and air conditioning contractor is Wolff & Munier, Inc., under the direction and supervision of Shreve, Lamb & Harmon Associates, architects; Jaros, Baum & Bolles, consulting engineers; and Turner Construction Co., builders.

At the Mutual Life building, a snow melting system serves 12,000 sq ft of sidewalk area (photo courtesy Bethlehem Steel Co.)

Round-Table Sessions Feature HPAC Contractors' Convention

SUNNY CALIFORNIA skies and the scenic and other attractions of a great city competed with the general morning sessions and the afternoon round-table discussions at the 61st annual convention of the Heating, Piping and Air Conditioning Contractors National Association in San Francisco last month. However, the delegates and their guests seemed able to find time to "do the town" as well as to attend to the association's business

EXPANDING A practice established in recent years, a series of round-table sessions on various subjects featured the 61st convention of the Heating, Piping and Air Conditioning Contractors National Association held in San Francisco last month. Despite the counter-attractions of perfect weather, Fisherman's Wharf, Chinatown, Muir Woods, and the Top of the Mark, these informal afternoon discussion groups on pipe welding, radiant panel heating, air conditioning, and apprenticeship training in the pipefitting industry were well attended, as were the general morning sessions.

Radiant Heating Facts and Opinions

F. W. Hutchinson, professor of mechanical engineering at the University of California, disregarded his assigned subject of What the Heating Contractor Should Know About Panel Heating, as he felt it "no more suitable" than a recent talk he had heard on What a University Professor Should Know About Teaching, which was given by a congressman. Instead, he gave a series of items of "fact versus opinion" in radiant panel heating practice. The item that attracted perhaps the most attention was his statement that "a surprisingly large proportion" of the heat to a floor panel—35 percent and more with an ordinary floor slab with no insulation, under steady state conditions—is lost to the ground, as contrasted with the rather generally held opinion that the earth acts as an insulator and that therefore this loss is low. His statement was based on experimental data which have been obtained but not yet published. This work indicates the great importance of installing adequate insulation under floor panels.

This may explain, he said, the disagreement about the maximum amount of heat release from a floor panel. With a higher loss to the ground than has been assumed, such a panel might *receive*, say, 90 Btu per sq ft per hr but much of it would be lost to the ground. In his experience, he stated, 50 Btu per sq ft per hr is the maximum heat release to the space being served, for any floor panel.

There are a dozen or more ways to design a radiant panel heating system, Professor Hutchinson remarked, and opinion seems to be that a different design method must be used for each heating scheme. The fact is, he said, that the method is exactly the same for each case. How much panel area at what temperature? is the first question, and the second is how to get the heat there.

The greatest stumbling block in radiant heating is the lack of unified thought, he said. A standardized design procedure is needed, he stressed, and attempts should be made to get engineers, contractors, and architects to agree on a design method.

On the matter of air temperature with a radiant panel heating installation, some opinion is that this can be as low as 60 deg for comfort. The fact is, he stated, that in a building without mechanical ventilation there is no possibility of achieving comfort at an air temperature any lower than 68 deg. It is possible with radiant heating to keep the air temperature down to 68 or 70 deg, he remarked, because of the very much reduced cold wall effect.

Continuing the "fact versus opinion" theme, Professor Hutchinson said that a commonly held opinion is that if the surfaces of a room are of a material which is highly reflective to heat, the heat losses would be reduced to the extent that no heating system at all would be necessary. However, there is no possibility of practically achieving this effect in a standard size room, he stated.

As to the so-called "indoor sun" effect of radiant heating, he said that the objective of a radiant panel system is to establish a general feeling of warmth in the room or space.

Another "opinion" on which he commented is that panel cooling is impractical because of condensation in the room. On the contrary, he said, it is perfectly possible and is technically desirable to circulate water in summertime in the panel heating coils at temperatures of 70 deg and above to abstract "up to 60 percent" of the lighting load, thus reducing the load on the air conditioning system.

Taking up the question of control of a radiant panel heating system, Professor Hutchinson said that with a properly designed system and with a "reasonable ratio" of the thermal capacity of the slab to that of the building (not a thick floor slab in a light sheet metal structure, for example) there is no reason why a simple on-off thermostat won't maintain comfort. A heavy slab in a light structure will cause control difficulties, however.

In multiple story buildings, some opinion is that a ceiling panel can also provide a substantial part of the heat to the floor above. This is a satisfactory method if the fraction of the heat going up is small—15 percent or so, in his opinion. However, if the fraction is large there will be a continual "wave" or "hunting effect" from bottom to top of the building. In commenting on ceiling and floor radiant panel heating installations, Professor Hutchinson pointed out that the heat dissipation or release of a ceiling panel is approximately twice that of a floor panel (assuming a 120 deg surface temperature in the ceiling case, and 85 deg for the floor installation), and therefore a smaller panel is required for ceiling rather than floor installation. This does not mean, he cautioned, that the ceiling panel is necessarily the economical choice, as the cost of the two constructions might throw the advantage one way or the other.

Opinion holds that tube spacing and tube diameter are extremely important insofar as heat release from a panel is concerned, but research has shown that such is not the fact, said Professor Hutchinson. He stated that tube spacings over a range of 4 to 9 in. and tube diameters from ⅜ to ¾ in. have "no practical influence" in changing the heat release rate of 0.77 Btu per hr per lineal foot of tube per deg difference in temperature between the water in the tube and the panel surface.

Milwaukee Standards for Radiant Panel Heating

At the round-table session on the subject held the same afternoon, Walter H. Oleson, executive of the Heating, Piping and Air Conditioning Contractors Milwaukee Association, who presided, presented the minimum standards for radiant panel heating approved by the Milwaukee group.

These minimum standards are based on the number of Btu's per lineal foot of pipe or tubing and are used when designing all panel jobs. For ⅜ in. ID pipe or tubing, the figure is 45 Btu; for ½ in., 60 Btu; and for ¾ in., 80 Btu.

On floor installations the minimum spacings (center to center) are, for the three diameters, 6 in., 7½ in., and 9 in., respectively.

On ceiling and wall panels the minimum spacings (center to center) are 4½, 6, and 7½ in., respectively.

The following pump sizes and coil lengths are standard, according to the Milwaukee recommendations:

	⅜ in.	½ in.	¾ in.	1 in.
1 in. pump	1050	540	500	450
1¼ in. pump	1950	1080	975	900
1½ in. pump	3150	1620	1500	1350
2 in. pump	6650	3600	2800	2700
Coil length	175	180	280	450

No coil installation should be made without a balancing cock or valve for every coil, and in sizing boilers, the loss for the entire structure should be figured in accordance with the HPACCNA standards and then 10 percent added, with the boiler selected on this basis, Mr. Oleson said.

In the subsequent discussion, it was pointed out that the Btu figures in the Milwaukee standards do not agree with Professor Hutchinson's 0.77 Btu figure. It was also stressed from the floor that greatly simplified design methods might lead to installations which will be unsatisfactory. In reply, Mr. Oleson said that the Milwaukee method had been used with success on numerous installations, and that if a panel were undersized, the job is easily corrected by boosting the water temperature as much as may be necessary.

In a supplementary report of the HPACCNA's radiant panel heating committee, which was read at one of the convention sessions in the absence of Chairman P. B. Gordon, it was announced that Part VI of the association's engineering standards would be developed for publication and would cover radiant heating. Also, a snow melting booklet will be published this fall. Slides and notes on radiant heating and snow melting are also to be developed for use at local meetings.

Snow Melting an "Untold Potential"

Snow melting provides an "untold potential" of future business for the contractor, according to the report of the association's trade promotion committee. This committee also recommended in its report that the heating, piping and air conditioning contractor do whatever he can to "put the coordination of plans back on the architect and engineer, where it belongs". It suggested also that a clause requiring the general contractor to shift or move beams to avoid interference with the heating, piping and air conditioning work be inserted in all contracts.

The report also included an "overhead" survey based on reports from members. In discussion, H. A. Snow, of Boston, remarked that he preferred the term "burden" to "overhead", as "it is on our backs every day". He said that the industry must pay more attention to business management, and suggested a round-table session on the

subject be held at the next HPACCNA convention.

Arbitration Board for Pipefitting Industry

Martin P. Durkin, general president of the United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States and Canada announced in his convention address the establishment of a national arbitration board made up of representatives of the United Association, the HPACCNA, and the National Association of Master Plumbers, and said this was a practical plan to keep bargaining within the industry and free from "government interference." Decisions of this board will be binding after collective bargaining has failed, and no decision will be rendered by the board unless the case is voluntarily submitted by both sides after normal collective bargaining efforts have failed. The board will give no consideration to a dispute while a strike or lockout exists, and the board will not consider any jurisdictional disputes.

Mr. Durkin stressed also the importance of improving the training of journeymen and apprentices to the highest possible level, and urged the use of educational films as a method of teaching. He expressed the United Association's wholehearted endorsement of the stand the HPACCNA has taken for the separation of contracts and he remarked that he felt the actions taken by the general contractors and the architects in opposing segregated bids for mechanical work were hasty. He said that the argument that separate contracts take authority from the general contractor and make the coordination of projects by the architect more difficult is untrue; he stated also that in some cases general contractors cause rather than prevent jurisdictional disputes. He decried the practice of bid shopping by general contractors, and said that it brought down the quality of work.

In his introductory remarks, Mr. Durkin mentioned that the United Association has tripled its membership since 1928, and that he expects it to go to "much higher levels."

Robert B. Miller, chairman of the committee on industrial relations, described the development of the plan to settle disputes in the industry peaceably, and complimented Mr. Durkin for sponsoring the plan "which holds such promise of greatly improving the relationship" between his organization and the HPACCNA and the National Association of Master Plumbers.

In reporting as representative on the American Standards Association council, Rowland Tompkins listed the ASA standards of interest to the HPACCNA since his previous report.

Construction Industry in Healthy Condition

At the opening session of the convention, Donald Beach Kirby, president of the Northern California chapter of the American Institute of Architects, greeted the contractors on behalf of the architects and emphasized that the architects are vitally concerned with heating, piping and air conditioning problems because questions that affect one part of the building industry affect all of it. All segments of the construction industry must keep up-to-date on new developments and new methods, he said, for every dollar saved in one place is available for other construction. We have never approached meeting the entire construction needs of the nation, he stated.

Not only public but private work as well should be programmed in order to stabilize the construction industry, and it should be realized that it takes longer to plan and finance a project than it does to actually build it. The construction industry is in a healthy condition today, "and it is up to us to see that this condition is maintained," he said. He warned against allowing the construction industry to become a political or economic football.

He prefaced his remarks by mentioning the architect who had designs on a contractor's daughter—"every time he made plans, she drew the line."

Also, at the opening session, an inspirational address was made by Dr. William H. Alexander, of "Oklahoma's Little Church Around the Corner." He was introduced by Howard Spindler, of American Radiator & Standard Sanitary Corp.

Nicholas J. Morrissey, registrar of contractors for the state of California, described the development of the contractors' state license law since its enactment in 1929, the examination required for a license, and the 16 provisions incorporated in the law for revocation of a contractor's license. It was made clear in the subsequent discussion that the association was not backing similar laws in other states, but that the law had solved some of the industry problems which are perhaps peculiar to California due to the influx of population there.

Enforcing Codes on Refrigeration

In his report as chairman of the committee on refrigeration, Austin S. Ford said that the codes developed by the American Society of Refrigerating Engineers are adequate but that "the effort fails of its purpose because of the lack of authority to secure their universal adoption and enforcement." The committee feels that for the HPACCNA to prepare codes of its own would be a duplication of effort; rather, it is felt that the association should concentrate on a campaign to have the ASRE codes "enforced."

The committee has been actively interested in the B-9 safety code for refrigeration, and believes that it will be workable and acceptable in practically all sections of the country, he said. This code should be utilized as a pattern for good installations, he recommended.

Hot Water Heating

Reporting for the home heating committee, Chairman J. A. Ljunggren said that the application of 240 Btu output on hot water heating systems is being accepted by the trade, but perhaps not as rapidly as was anticipated.

He referred to the safety loop shown in the 1944 HPACCNA booklet No. W-1, which is "of the utmost importance" for hot water systems in one story buildings where radiation and boiler are on the same level, with mains under the floor. The safety loop is merely an equalizing or circulating line connecting the bottom of the air cushion tank to the return line of the boiler.

The question of boiler water temperature delivery on some types of small boilers was broached at the last convention, Mr. Ljunggren said. Since that time it has come to the committee's attention that this

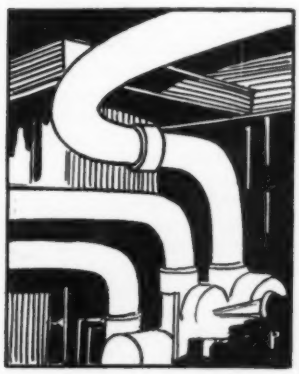
trouble has been experienced on floor panel heating where low temperatures are required, whereas previous complaints were made on high temperature hot water installations.

When complaints on failure of heating systems were registered it was found that the leaving water temperatures at the nozzle outlet of the boiler were 20 to 40 deg lower than the aquastat setting and the boiler thermometer readings. Boiler aquastats set at 215 were delivering water at 180 deg and less and the same differences in temperatures existed regardless of aquastat setting.

More recently a contractor stated that a number of floor panel heating installations designed for 130 deg leaving water temperature, failed to deliver water above 90 deg. In order to obtain 130 deg water it would be necessary to set the aquastat at 170 deg. With that type of work it would not be safe to operate under those circumstances. Some manufacturers and control people are now making an intensive study to cure these conditions, he said.

If there are members of the association having heating complaints, it is suggested that before the engineering and the installation are condemned a temperature reading instrument be employed in order to ascertain exactly what water delivery is being obtained as against the boiler thermometer reading. When purchasing equipment it would also be well to have the manufacturer furnish a guarantee as to temperature delivery.

On a multiple building, heated by hot water, where apartments are individually controlled by means of a thermostat and motorized valve and are supplied from a main constantly circulated, a nuisance complaint has developed.



In the case of an apartment being satisfied, the thermostat has shut off the supply valve, and it has developed that the return from this apartment will gravitate enough to continue to heat one or two radiators that are located closest to the return connection at the main, thereby causing discomfort during mild weather in the rooms where these radiators are located.

In order to insure against this failure, installation of a check valve in the return from each apartment before connecting into the main return line is suggested by the committee.

Furnace Volume for Steel Boilers

In the report of the boiler output committee, of which George P. Nachman is chairman, it was stated that in the steel boiler field an effort has been made to publish the furnace volume that is actually above the mud ring of the boiler and to indicate by means of a star and footnote if such volume is below the minimum Steel Boiler Institute requirements.

This particular furnace volume is important if the boiler is to be used with coal, either hand fired or stoker fired, according to the report. However, if oil firing or pulverized fuel is to be used, the furnace volume would be increased by the volume of the base. In order to establish a standard, it was decided to publish the actual furnace volume above the plane of the mud ring. Since the height of the base may vary due to the type of burner or fuel, the method appears to be a reasonable and logical approach.

Pipe Welding Methods Discussed

In his report as chairman of the board of trustees of the National Certified Pipe Welding Bureau, William W. Murray, Jr., said that there are now 17 chapters (with requests for information from four other localities) and that these 17 chapters have 232 members. These chapters have tested and qualified under the procedures and have interchanged qualification test records of 1128 welders.

In addition to the three procedures previously qualified and in use by members, the bureau has just qualified two procedures for the welding of chrome molybdenum alloy steel pipe, one in the ½ of 1 percent molybdenum range and the other in the 1 percent molybdenum range. These procedures, together with the test qualification test data, are now being reproduced and will be furnished to all members of the bureau for their use without further qualification of the processes.

The bureau also has formulated and adopted a standard specification provision that is being recommended to architects and engineers for inclusion in their specifications to cover the requirements for the fabrication and erection of welded piping, and has sent a series of letters to architects and engineers promoting pipe welding by members of the bureau under standard welding procedure specifications which meet welding code requirements.

The bureau has also prepared an instruction booklet for pipefitter welders, which is being sent to all members of the bureau for their use.

There are two reasons for difficulty in getting good operators, according to Robert S. Green, assistant professor and acting chairman of the department of welding engineering at Ohio State University, and consultant to the National Certified Pipe Welding Bureau, in a convention address. These are lack of knowledge to pass the test, and unwillingness to follow the procedure specifications.

To help applicants to qualify, he suggested that it be made sure that they have read and studied the procedure specifications, that the joints are prepared accurately, and that the applicant make test plates to be sure he can put in a root pass that will stand up. He suggested that the instructor get on the other side of the weld and watch the metal going in in order to be able to tell the operator where he may be going wrong.

Richard S. Tobin, chairman of the committee on welding, presided at the round-table session on that subject. One question brought up from the floor was the difficulty encountered in getting operators to pass the gas welding tests. In answering this comment, Professor Green remarked that the trick is to do the welding as fast as possible in order to avoid increasing the grain size; too often, an operator

taking a test will, in an effort to be careful, weld too slowly. It was also mentioned that one trade school is using a reducing rather than a neutral flame with good success.

Students of welding will sometimes lay on rod without melting the base metal, and others will heat too long, Professor Green remarked, but they quickly learn the proper method.

It was stated from the floor that the procedures of the welding bureau seem to tend away from the use of back-up rings, and that the ASME code does not consider a man qualified to weld without back-up rings as qualified to weld with rings. In answer, Professor Green stated that the bureau procedures with the use of back-up rings optional have been accepted by boiler inspectors and insurance companies throughout the country, although this does not comply with the letter of the ASME code. It was stated that in New York, an operator is accepted as qualified to weld with back-up rings if he has passed the test without the use of rings.

Considerable attention was devoted to methods of preheating and stress relief of welded piping—particularly the economical balance between different methods insofar as the cost of labor and the cost of equipment are concerned. One contractor mentioned that his organization uses a six-point recorder for a record of stress relief temperatures overnight. The equipment cost is high, he said, but the method saves a lot of labor time. Three thermocouples are spaced equally around the pipe on each side of the welded joint, and the resulting stress relief record is kept on permanent file.

Mr. Tobin mentioned in this connection that on ½ percent chrome, ½ percent moly, the contractor can go back at any time after welding to stress relieve. This is not true with 1 percent moly, however, he warned.

Welding Procedures for Alloy Pipe

The principal work of the research committee—of which John H. Zink, Sr., is chairman—during the year has been in establishing welding procedures for welding different grades of stainless steel, nickel, and chrome-moly pipe and fittings. It would be comparatively simple to write acceptable procedures for the use of these alloy materials, in the low and medium pressure fields, but in the high pressure field there still remains an honest difference of opinion as to the merits of these materials, according to the report. This should be cleared up during the coming year so that a welding procedure acceptable under the codes for welding these materials can be provided. In the meantime, the National Certified Pipe Welding Bureau is preparing acceptable welding procedures to be used for the present.

Mr. Zink is also chairman of the editorial committee for the Standard Manual on Pipe Welding. According to this committee's report, the decision of the American Standards Association to revise the Code for Pressure Piping made it necessary to hold open certain chapters of the manual. However, some 22 chapters of the manual are ready for printing.

Air Conditioning and Merchandising

W. S. Bodinus, chairman of the air conditioning committee of the HPACCNA, reported that during the past year Part IV of the association's engineering standards on the design of comfort cooling air conditioning installations had been distributed to the membership.

The committee has taken an active part in the discussions and analysis of the water conservation programs which are of considerable concern in almost all parts of the country. The restrictions for the use of city water for condensing purposes in air conditioning and refrigerating systems will increase the initial cost of these installations and may have a tendency to retard progress, he said.

Where water shortage is a real problem, the committee has strongly recommended the use of cooling towers and evaporative condensers. There are some cases where the water shortage problem is not too seriously affected by the hours of operation of air conditioning equipment, and in these cases the committee has tried to dig out the facts and present them to the authorities having jurisdiction over the control of water supply, Mr. Bodinus said.

In an afternoon round-table session at which Mr. Bodinus presided, the principal topic of discussion was the merchandising and application of self-contained air conditioning equipment. It was pointed out that such equipment represents a merchandising problem to a large extent, and is therefore somewhat different from the contractor's other business. The merchandising is truly creative, as without the selling there is no installation—it is "created by selling," according to one of the viewpoints expressed. Technical care and skill must be exercised in the application of even the smaller sizes of self-contained equipment, it was pointed out, as mis-applications will retard the entire industry.

The contractor must plan boldly and intelligently for sales of heating and piping as well as air conditioning installations, said Paul K. Addams, president of the Fitzgibbons Boiler Co., in his address at one of the general sessions of the convention. Such planning involves finding the markets which will yield the greatest volume and profits, evaluating those markets, and eliminating wasteful selling practices. He said the heating and piping industry will do a billion dollars worth of business in 1950.

Visual Aids for Apprentice Training

Arnold H. Goelz, chairman of the association's committee on apprenticeship, reported that the principal topic discussed at this committee's meeting had been visual aids for apprentice training, and that a slide film with accompanying sound on methods of joining copper tubing is now available. The film itself was shown at one of the sessions; it explains the four types of fittings —solder, brazed, flared and compression—and shows the various steps involved. According to Mr. Goelz, visual aids are also to be developed on setting cast iron boilers and on forced hot water heating systems, and the National Certified Pipe Welding Bureau has agreed to develop visual aid material.

Use of visual aids for apprentice training was also stressed at the round-table session on this subject. In an address at a convention session, Maurice M. Hanson, assistant director of the bureau of apprenticeship of the U. S. De-

[*Concluded on page 93*]

QUESTION of the Month

SUPPLYING COMBUSTION AIR TO FURNACE ROOMS

IT HAS BEEN noted that in the April HPAC, "B.N." requests information on supplying combustion air to a furnace room.

In the American Standard Requirements for Installation of Gas Equipment in Large Boilers as sponsored by the American Gas Association, 420 Lexington Ave., New York 17, it will be found that paragraph 1.2 on page 1 refers to combustion air and presents a commonly accepted standard for providing air from the outside to a space in which a boiler is located.

This paragraph reads as follows: "Properly designed permanent facilities for supplying an ample amount of outside air to permit complete combustion of the gas shall be provided in accordance with the burner manufacturer's instructions. Where combustion air is taken from the space in which the boiler is located and no manufacturer's instructions are available, it is suggested that an opening to the outside air be provided having an area of 0.5 sq ft or more for each 1,000,000 Btu per hr of gas burned."

These requirements may be obtained from the American Gas Association upon request.—GEORGE C. BERGTHOLDT, The Webster Engineering Co.

QUESTIONS UNIT SYSTEM FOR 21 STORY BUILDING

THE COMMENTS of "H.W." in the Question of the Month columns of the May issue, in answer to my request for ideas on air conditioning a 21 story building, are most interesting and merit careful consideration. Regarding costs, however, as mentioned in his last paragraph, I believe that many office building owners are vitally interested in total owning and operating costs in which the amortization of equipment cost and interest on the initial investment sum are only a part of the picture. What about the servicing of the 126 or 147 or more air conditioning units suggested by "H.W."?

Seven units per floor would mean 147 compressors and motors, 147 fans and motors, 147 control items of each type, etc. Does "H.W." have any comparative complete owning and operating costs covering all the items, including servicing the units, for his suggested unit system?

Would "H.W." recommend pumping the condenser water from and to the cooling tower continuously through all the units during all cooling hours, or how would this be handled? The question also arises in my mind as to why companies who make all types of air conditioning equipment seldom recommend the system described by "H.W." for such a building.—G.B.

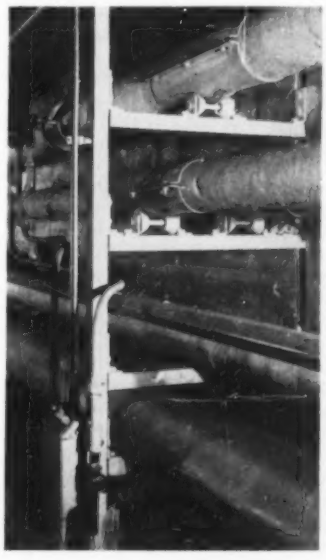
FRAMING METHOD FOR TUNNEL PIPING RUNS

A RELATIVELY new system of framing, recently adapted to the task of supporting heavy piping runs, has been erected in a large tunnel installation at G. D. Searle & Co., Skokie, Ill., manufacturer of pharmaceuticals.

Made from steel channel and fittings, the stanchions were assembled on the job to continuous concrete inserts embedded in the ceiling and walls and bolted to the floor. Pipe was then installed on roller pipe supports fitted to the horizontal framing members.

The system used in this tunnel installation is said to have a number of distinct advantages. The structure is completely flexible, in that variations in pitch or slope are permitted by the mere loosening of the bolts which tightly clamp together the framing members involved. Thus, if changes or additions are desired, these adjustments may be made quickly and easily without the use of special tools. Another feature is the reduction of detailing time generally required when a project of this kind is in the engineering phase, and the elimination of drilling or welding. (Photo courtesy Unistrut Products Co.)

The stanchions were assembled on the job to continuous concrete inserts embedded in the ceiling and walls and bolted to the floor for supporting this piping in a large tunnel at G. D. Searle & Co.



ASKS EFFECT OF FLOOR HEATING ON PUPILS

YOU ARE INVITED *to answer the following question which has been asked by a contractor reader of HPAC. Suitable comment on the matter will be welcomed and—space permitting—will be published. Suitable sketches or photos are particularly desired. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2:*

"We are involved in the installation of a radiant heating system in the floor of a school, and have been asked by the school authorities about the effect such a system may have on the pupils. We have installed a number of these heating systems, but only one school job, and would therefore appreciate knowing of the experience of others in such cases."—W.H.

HOW TO SERVICE

Air Conditioning Jobs

ARMAND COWAN, president of the Stuart Cooling Corp. of Florida, contributed a detailed reply to a request for information on organizing and operating the servicing department for an air conditioning contractor, which was published as the Question of the Month in one of last year's issues of HPAC. Copies of this issue have been exhausted, and it has been suggested that Mr. Cowan's material again be made available. He has therefore checked it over carefully, and it is published this month

PERFORMING air conditioning service on a large scale over a 24 hr a day period can be an extremely costly procedure unless adequate control of inventory and disposition of the mechanics are exercised.

Materials must be kept in stock for service required when supply houses are closed, yet the space and money required would be disproportionate to the volume of business if a careful control were not kept to assure that no parts are lacking when required, that a minimum amount of rarely used parts is stocked, that supplies requiring lengthy delivery are ordered sufficiently in advance, and that a careful record of the inventory is available to the purchasing department.

A service organization must be just what the name implies. It must give service to the customer, and it must be an efficient organization unto itself—or the service manager will soon be replaced by the sheriff. If fair rates are charged and inefficiency prevails, a loss will be incurred. If the customers are charged for its short comings, they will very shortly call another service organization to do their work.

After 15 years of engineering, installing, and servicing commercial, industrial, and residential air conditioning equipment along the entire Atlantic seaboard from Maine to Florida, (as well as the hinterlands), we have come to the conclusion that in that entire area there is no section where the service problem is as great as in the South Florida area because of the climate, usage of equipment, and operating conditions. If our contention is correct, conditions of inefficiency that are minor in other sections are greatly magnified here and can mean the difference between large losses or fair profits.

Although only service organizations in our particular locality would be interested in all of our service procedures, we believe that we have all of the service problems that may only be partly encountered in other parts of the country. The only exception would be protection against freeze-ups, and we will endeavor to touch on that problem later.

Water, Long Operation Are Problems

The semi-tropical climate that brings so many tourists and vacationers to South Florida annually presents a corrosion problem similar to that experienced by the Army and Navy on the Pacific islands during the war.

Water available for condensing purposes is extremely hard, coating condensers and pipe with calcium carbonate and sending condensing pressures to 175 lb within six months if not properly maintained.

Regulations prohibiting disposal of condenser water into municipal sewage systems require that cooling towers or evaporative condensers be used even on 3 and 5 ton self-contained units.

The design wet bulb temperature is 79 F, causing higher condensing pressures than those considered standard throughout most of the rest of the country.

Our greatest industry is tourist travel—people on vacation who don't go to work the following morning. As a result, many restaurants are open all night, and hotels run their air conditioning systems 24 hr per day. Because of the high temperatures prevailing the year 'round, the air conditioning systems must operate a minimum of 10 to 11 months a year. Certain establishments, where the main heat source is internal (lights and people), have actually operated 24 hr a day 365 days a year.

It thus can be realized that because of longer hours of operation at higher pressures than normal, with extra equipment such as evaporative condensers or cooling towers on practically every job, coupled with the rust problem, the hard water situation, and the occasional damage due to hurricanes, there is

no area in this entire country where so much air conditioning service is required, and where attention must be paid to so many details of operation.

Methods of Servicing Customers

Several methods are used to maintain rapid and efficient service at nominal cost to the customer.

First, a customer may take service on a per call basis, or may use one of our three maintenance or service contract plans. These plans have advantages both to the user and the service company.

The advantages to the customer include reduced service costs, averting breakdowns before they occur, and keeping the equipment at peak efficiency. To the contractor, the advantages include scheduling men in advance, affording mechanics steady work, accurately forecasting volume, reducing overtime requirements, and greater profits.

Our first contract service plan is monthly maintenance only. Our second is monthly maintenance plus emergency service, and our third plan is the same as the second with the addition of rust retarding.

Our service contract agreement is reproduced here. However, such a contract form for any particular locality should of course be framed in accordance with the laws of that state or area.

Mechanic Takes Check List

When a mechanic is dispatched from the office for a monthly maintenance check, he takes the monthly maintenance check list reproduced here with him. He goes through the 48 steps listed thereon, taking care of those items that apply to the particular installation. As an illustration, let's run through the list, discussing the matters in the manner that the service man would operate.

No. 1: Lubricate motor bearings. The compressor motor is lubricated with oil or grease as required.

No. 2: The compressor oil level is checked in a sight glass and refrigerant oil is added if required.

Nos. 3-4-5: All systems above 10 hp are equipped with permanent gages. The mechanic reads and records the head pressure, suction pressure, and oil pressure. Should any of these be other than normal, proper steps are taken to correct the condition.

No. 6: The system is pumped down to ascertain that the low pressurestat will shut the system off at the proper pressure. The compressor is also operated without the condenser to ascertain that the high pressure cutout stops the compressor at the proper temperature.

No. 7: The compressor bolts are checked and tightened at six month intervals unless some very evident indication is seen that it is required between these six month inspections.

No. 8: Refrigerant is checked in the sight glass, and if required, additional refrigerant is added.

No. 9: Test for leaks. The average job leak test is made at the seal, at flare connections, and any other point of known leakiness. At each inspection an entire recheck is made whenever there is any indication of refrigerant lost.

No. 10 is self-explanatory.

No. 11: Compressor belts are checked for proper tension and alignment.

Nos. 12-13-14: Pump and fan motor, evaporative condenser, and cooling tower are properly lubricated, as well as the pump and fan.

No. 15: At six month intervals the condensing coil is checked for chemical deposits, scale, or dirt, and if found, they are removed.

No. 16: Water spray nozzles are checked at each call to make sure they are not clogged in any manner, and if they are found clogged they are cleaned.

Nos. 17-18-19: The strainer screens for the city water make-up, the pump intake, and the outside air intake are checked, and cleaned if required.

No. 20: The make-up float control is checked to ascertain that a proper water level is maintained, and reset if incorrect.

No. 21: All water connections to the unit are checked for leaks.

Nos. 22-24: Condenser belts are checked, and are aligned and tightened if required.

No. 23: Rotation of fan is checked upon the first call, or any specific call after electric changes have taken place in the building.

No. 25: The entire unit is examined minutely for rust, and a report submitted that is later followed up by another mechanic whose sole duties are rust retarding.

Nos. 26-27: The mechanic checks the condition of the water softener container and adds the required amount of water softener. This retards rust and chemical deposits as well as the growth of algae and fungi in the sump.

No. 28: Water regulating valve is adjusted, if required.

No. 29: At 90 day intervals the air cooled condenser is thoroughly cleaned.

Nos. 30-31: The fan and fan motor bearings of the air unit are properly lubricated. Belt condition, tension, and alignment are checked, and corrected if required.

No. 33: Replaceable type filters are changed and renewable filters are cleaned.

No. 34: Blower wheel fan alignment is checked, and corrected if required.

No. 35: Refrigerant strainer is checked, and cleaned if required.

No. 36: All water connections are checked for leaks.

No. 37: A complete report on rust is submitted together with the report aforementioned in Item 25, and attended to at the same time.

Nos. 38-39-40: Thermostat, starter, damper motors, and other electrical installations are checked for proper operation, and corrected if required.

No. 41: Damper settings are marked on the ducts and the mechanic checks to see that settings have not been altered or quadrants loosened, and resets dampers when required.

Nos. 42-43: On the few well water jobs, the pump and pump motor are lubricated and air is purged by means of a petcock.

No. 44: The manager is instructed in the operation of the installation on the first call after a change of management.

No. 45: If any changes are made to the system, such as resetting controls or dampers or any precautions to be taken until the mechanic should call back, the manager is completely informed.

No. 46: In the event that the decalcomanias placed on the door advertising air conditioning within the premises should have deteriorated, these are scraped from the window and replaced.

No. 47: All parts of the system are wiped clean with rags.

No. 48: The mechanic gets a work order ticket from the customer as a

AGREEMENT

Stuart hereby agrees to furnish and Purchaser hereby agrees to pay for inspection, maintenance, rust retarding, and service subject to the following conditions, for the equipment only, located at the aforementioned premises.

The equipment covered by this agreement includes the following compressors and mechanical systems of which they are a part. Duct-work, plumbing, wiring, insulation, or any other work that is not an integral part of the refrigeration cycle is not included.

Stuart agrees to make_____ inspections each year, and at time of inspection, to perform the normal services listed below:

1. Inspect equipment for refrigerant leaks.
2. Repair all leaks in refrigerant mains.
3. Clean commutators on motors.
4. Clean all motor housings.
5. Clean condenser annually on water-cooled systems.
6. Clean lint and dirt from air-cooled condensers.
7. Clean condensing units.
8. Clean all strainers.
9. Adjust tension on all belts.
10. Lubricate all moving parts.
11. Check operating pressures of condensing units.
12. Purge air from systems.
13. Check refrigerant in systems.
14. Charge refrigerant into systems as necessary.
15. Inspect and adjust temperature controls.
16. Inspect and adjust safety controls.
17. Inspect and adjust all valves.
18. Adjust water regulating valves.
19. Check operation of refrigerant controls.
20. Supply emergency service between regular inspections.

And on air conditioning systems to:

1. Clean steam traps or electric heaters.
2. Check and adjust dampers and air distribution.
3. Change over and set controls for seasonal operation.
4. Inspect air filters.
5. Clean evaporative condensers or cooling towers.
6. Clean drip pans.

Rust Retarding:

1. Examine all parts at intervals not exceeding 6 months.
2. Where rust is found, chip, scrape, and wire brush same until bare dry shiny metal is discernible.
3. If this surface is not in constant contact with water, apply zinc chromate or red lead.
4. If this surface is in contact with water, apply heavy coating of bituminastic paint or hot pitch.
5. After application, 3 or 4, as required, paint entire surface with aluminum paint.

It is assumed that, at the time that this agreement is entered into, all machinery is in proper operating condition. However, the following equipment is not in proper condition for reasons mentioned below, and any service necessitated by these items shall be charged for at our regular billing rates until such time as these deficiencies are corrected.

Stuart agrees to furnish the following materials as and when necessary:

1. Necessary lubricant (oil or grease) for fan and motor bearings.
2. Necessary fuses.

It is mutually agreed:

1. That Stuart shall not be required to furnish replacement parts, refrigerant and supplies other than those listed above, or to repair damage to the equipment due to causes beyond our control. Additional materials will be furnished by us at our regular selling prices, less 10 percent.
2. All work to be performed during Stuart's regular working hours of regular working days. If, for any reason, Purchaser requests that examinations or adjustments be made on overtime, Purchaser agrees to pay the difference between regular and overtime labor at regular billing rates.
3. Any additions, alterations, adjustments or repairs made by others, unless authorized by Stuart, shall terminate Stuart's obligations hereunder. Stuart is not obligated to assume the charges or to make a refund to the Purchaser for any service work performed, or for any material furnished by persons other than Stuart.
4. Any repairs, refrigerant and supplies other than those listed above deemed necessary and recommended by Stuart for efficient operation of Purchaser's installations are to be authorized by Purchaser. Unless these recommendations are accepted by Purchaser and authorization given to perform this service, Stuart will not furnish emergency service. The Purchaser shall accept the judgment of Stuart as final as to the means and methods to be employed for any corrective work.
5. In the event Stuart is required to make emergency calls occasioned by the improper operation of the equipment or due to damage caused by floods, lightning, fire, elements, rebellion, riots, strikes, labor troubles, civil commotion of any kind, or due to Purchaser's failure to follow Stuart's recommendations as noted in Item 4, or for any causes beyond Stuart's control, Purchaser shall reimburse Stuart for the expense incurred in making the emergency call in question, in accordance with the current established rates for performing such service.
6. Stuart shall not be liable for the operation of the equipment nor for injuries to persons or damages to property, except those directly due to the negligent actions or omissions of Stuart's employees. Stuart shall not be held liable for any loss or damage due to delay in furnishing labor or material for any cause beyond Stuart's reasonable control, and in any event Stuart shall not be liable for any consequential damage.
7. The amount of any past or future sales, use, service, excise or other similar tax, Federal, State or Municipal which Stuart shall now, or hereafter be liable for, or required to pay, either on Stuart's or Purchaser's behalf or otherwise, with respect to Stuart's obligation to furnish services and supplies hereunder, shall be in addition to the sum payable by Purchaser under this proposal and shall be paid by Purchaser upon the rendition of separate invoices covering such tax.
8. Any violation on the part of the purchaser of any of the terms of this agreement, or non-payment of bills, rendered in relation to this agreement within 30 days of invoicing, shall be sufficient cause for Stuart to be relieved of their responsibility under this agreement and to cancel same without notice. In case suit shall be brought for collection of bills in relation to this agreement or same has to be collected upon demand of an attorney, purchaser agrees to pay reasonable attorney's fee for making such collection.

Stuart's inspection, maintenance, service, and rust retarding shall be furnished:

From: To:

for the sum of:

payable in advance as follows:

This agreement shall remain in effect for one year from date of signing and shall continue from year to year thereafter, at an increase of 10 per cent each year, unless thirty (30) days prior to the termination of any yearly period, either party gives written notice to the other of their intention to terminate same.

This agreement is signed in duplicate this_____ day of_____ and constitutes the entire contract between us. All prior representations or agreements not incorporated herein are superseded.

Accepted by:

STUART COOLING CORP. OF FLORIDA

_____ By_____

The service agreement for any particular locality should of course be framed in accordance with the laws of that state or area

JOB RECORD

NAME "XYZ" Restaurant

ADDRESS 000 Lincoln Rd. Phone: 1842

Compressor & air unit at rear on street floor. Evap. cond. on roof

PERSON IN CHARGE John Townsend

AIR UNIT Mfr. "A" R.P.M. 685 VOLTS 208

Mfr. "B" BELTS QUANTITY 2 SIZE B46

Mfr. "C" FAN MOTOR 2 HP PULLEY 4.2" PD HEATERS N25

FAN PULLEY 10.5" PD FILTERS NO. 8 SIZE 20X25X2

COMP. MOTOR Mfr. "C" R.P.M. 1725 VOLTS 208

Mfr. "D" BELTS NO 4 SIZE 96 B HEATERS N44

EXP. VALVE Mfr. "E" TEL 7F

MISC. Evap. cond. - standard Mfr. "F" EC 20

Upon starting a system, the mechanic in charge fills out a job record card, so that the shop has a record of all parts that might be required to keep the system functioning properly

MONTHLY MAINTENANCE CHECK LIST

JOB: "XYZ" Restaurant DATE: 12/6/48

COMPRESSOR
1. Lubricate motor bearings ✓
2. Check oil level ✓
3. Check head pressure ✓
4. Check suction pressure 115
5. Check oil pressure 34
6. Check pressurestat oper. ✓
7. Check head bolts ✓
8. Check refrigerant X
9. Test for leaks ✓
10. Check rotation ✓
11. Align & tighten belts ✓

EVAP. COND. OR Tower
12. Lubricate motor bearings ✓
13. Lubricate fan bearings ✓
14. Lubricate pump bearings ✓
15. Check coil (scale or dirt) ✓
16. Check spray nozzles ✓
17. Check water strainer (make-up) ✓
18. Check pump strainer ✓
19. Check air intake screen None
20. Check float control ✓
21. Check drip pan & drain conn. ✓
22. Check drive belts ✓
23. Check rotation of fan ✓
24. Align & tighten belts ✓
25. Rust (casing & pan) report ✓
26. Water softener container ✓
27. Water softener added 2.16

CONDENSER (Water Cooled)
28. Check water reg. valve None

CONDENSER (Air Cooled)
29. Clean condensing coil None

AIR UNIT
30. Lubricate motor bearings ✓
31. Lubricate fan bearings ✓
32. Check drive belts ✓
33. Check filters ✓
34. Check fan wheel alignment ✓
35. Check strainer ✓
36. Check drip pan & drain conn. ✓
37. Rust (casing & pan) report ✓

CONTROLS
38. Check thermostat operation ✓
39. Check starter operation ✓
40. Check damper motors ✓
41. Check damper settings None

WELL WATER JOBS
42. Lubricate pumps X
43. Purge air from lines

GENERAL
44. Instruct Manager in oper. ✓
45. Inform Manager of changes None
46. Check with Mgr. re decals O.K.
47. Wipe all dirty parts ✓
48. Get signed ticket for time & materials used ✓

MECHANIC, PLEASE NOTE: When completed, all items are to be checked, either with a ✓ to indicate work has been attended to, or an X to indicate item does not apply to this installation. This check sheet to be attached to signed service ticket and returned to Stuart at end of day.

STANDARD EQUIPMENT TO BE CARRIED BY MECHANIC: Mirror, gun and grease, flexible spout oil can, S.A.E. 30 oil, refrigerant oil, gages, leak detector, hand tools, rags, chalk, water softener.

MECHANIC'S REMARKS: Have you found evidence of rust? Yes
Have you circled and dated rust spots? Yes
Additional Remarks: Evap. condenser exterior rusted in several spots — interior O.K. — Air unit drain pan rusted near drain connection, Use other side of sheet, if necessary, for further remarks.

Signed by: H. Palmer
Mechanic

When a mechanic is dispatched for a monthly maintenance check, he takes this check list with him

SERVICE CARD

FOR

NAME "XYZ" RESTAURANT

ADDRESS 000 Lincoln Road

FOR AUTHORIZED SERVICE CALL

STUART COOLING CORP. OF FLORIDA

1335 N. W. 21st ST. MIAMI 42, FLORIDA

9-3819

DATE	SERVICE RENDERED	MECHANIC
12/6/47	Started system in operation	HP
1/3/48	Rechecked for leaks & insulated	HP
2-3-48	Monthly maintenance check	EHJ
3-2-48	Monthly maintenance check	EHJ
3-17-48	Repair leak – added 15# refrigerant	EHJ
4-2-48	Monthly maintenance check	EHJ
5-3-48	Monthly maintenance check	CJ
5-5-48	RUST TREATMENT	ECW
6-4-48	Monthly maintenance check	CJ
6-24-48	Replace fan belts	CJ
7/7/48	Monthly maintenance check	HP
8/6/48	Monthly maintenance check	HP
9/6/48	Monthly maintenance check	HP
10/5/48	Monthly maintenance check	HP
12/4/48	Monthly maintenance check	HP
12-8-48	RUST TREATMENT	ECW

RETURN THIS CARD TO OFFICE WHEN COMPLETE

JOB NO. 201 INVOICE NO. 500 Nº 2662

STUART COOLING CORP.

OF FLORIDA

1335 NORTHWEST 21st STREET

Miami 42, Florida

STUART Cooling

12/6 '48

SERVICE TO "XYZ" Restaurant

ADDRESS 000 Lincoln Rd.

BILL TO Same

SERVICE RENDERED Monthly maintenance check
Added refrigerant – oil. Repaired
flare fitting at head pressure gage

Material Used	Price	C.O.D.	Charge	No Charge
8 lb refrigerant			Total Material	
1 pt refrigerant oil			(2) Hrs. at Job	
6 20x25x2 filters			(1½) Hrs. Travel	
2 lb water softener			(3) Miles	
			Total Charge	

Job Completed ☑ Job Incomplete ☐

H. Palmer
Serviceman's Signature

We are not responsible for parts other than those furnished and installed by STUART COOLING CORP. OF FLORIDA.

Guarantees on all parts are limited to the guarantees given by the manufacturer to STUART COOLING CORP. OF FLORIDA.

No Verbal Agreements Will Be Recognized

The above described service and installation of parts listed has been authorized and hereby acknowledged. Equipment now operating satisfactorily.

Customer's Signature "XYZ" Rest./GC

***Left*—A service card is posted on the job and is filled out by the mechanic at each visit for future information. This reduces lost time in diagnosing trouble. *Right*—The work order ticket, which is signed by the mechanic and the customer, goes to the stockman, who records inventory changes, and to the accounting department**

receipt that the work has been accomplished and returns this maintenance check together with the work order, both signed by the mechanic, together with any additional remarks and advice the mechanic may make regarding the system. Work order tickets are padded in book form convenient for the mechanic to handle. These are in numerical order in duplicate, the original being retained by the customer and the duplicate being returned to the service manager. Both are signed by the customer and the mechanic showing the time spent on the job and the materials used.

Rust Retarding a Regular Service

Due to the combination of hard water, salt laden air, and high relative humidity found locally, one of the major problems has been with the rusting of equipment. This cannot be stopped entirely but the life of the metal can be prolonged by proper maintenance:

1) Examine all parts at intervals not exceeding six months.

2) Where rust is found, chip, scrape, and wire brush until bare, shiny metal is discernible.

3) If this surface is not in constant contact with water, apply zinc chromate or red lead.

4) If this surface is in contact with water, apply heavy coating of bitumastic paint or hot pitch.

5) After application (3) or (4), as required, paint entire surface with aluminum paint.

All applications to be made on dry surfaces.

Secure Equipment for Hurricanes

When monthly inspection is made, emergency calls are answered during normal working hours at no charge. When overtime is encountered, customers pay the difference between normal and overtime. The customer pays for all materials except lubricants at all times. In the event of damage by hurricane, fire, strikes, acts of God, or any other causes beyond our control, the customer pays for all labor and all materials required to correct the damage. At no additional charge, immediately before hurricanes, mechanics are dispatched to each installation where equipment is located out-of-doors, to make sure that all hurricane bracing, guy wires, and panels are properly fixed and tightened in order to minimize hurricane damage.

Spring and Fall Operations

In those areas where cooling is not required during the winter, certain precautions must be taken in the spring and fall.

In the fall, drain all water lines, condensers, cooling towers, or vessels containing water. Where water is trapped, add sufficient antifreeze.

Pump down all refrigerant into receiver and close valves.

Check and adjust heating operation when same is part of air conditioning system.

If no heating is included, securely close outdoor air openings to prevent drafts, and remove all fuses so that equipment cannot be operated.

In spring, refill all water vessels.

Perform all applicable items on check list.

Close heating system.

Replace fuses if removed. Adjust outdoor air openings, if closed.

Drop back after 8 hr operation for observation.

Job Record Card

Upon starting a system, the mechanic in charge fills out the job record card which is shown herewith so that the shop has a record of all parts that might be required to keep this system functioning properly.

From this job record card, we immediately stock spare belts and other items that need frequent replacing so that if a night club, restaurant, or hotel that operates into the early hours of the morning needs immediate service (for example, saying that a belt has broken) the night service manager consults the job record card and calls the mechanic at his home telling him what size belt is required. If the mechanic does not have the belt in his car stock, he stops by the office on the way to the job and the belt is ready and waiting for him.

Service Card Posted on Job

A service card is posted on the job and is filled out by the mechanic at each visit so that any new mechanic visiting the job can consult the card to get an idea of where and when and what sort of trouble has been encountered on this job in the past. This reduces lost time in diagnosing trouble.

Emergency service is supplied 24 hr a day, seven days a week. An adequate stock of spare parts is maintained to meet all probable conditions. Mechanics report by telephone to the office at the completion of each call, immediately before lunch, before quitting for the day, and before any overtime is done, so that at all times the office is familiar with the state of conditions in the field, and the whereabouts of each mechanic, enabling the service manager greatest flexibility in taking calls and dispatching them among the various service men.

Bills Prepared From Work Order Ticket

Before leaving the job, the mechanic gets the work order ticket signed in duplicate (as mentioned before), leaving the original with the customer and returning the duplicate to the service manager. The service manager then checks this ticket against the dispatch sheet, forwards it to the stockman who records inventory changes, and he, in turn, forwards it to the accounting department.

Bills are prepared directly from the work order ticket and mailed to the customer. Normal service accounts are payable within 10 days and then put on a COD basis until the account is current. Service contracts are payable the 10th of the following month and then put on a COD basis until current.

Perpetual Inventory of Parts and Tools

The company maintains three vehicles operated by employees, and other mechanics furnish their own cars for which they are allowed 6c per mile plus any tolls encountered, parking fees when necessary, etc. Mechanics work on an hourly basis with time and one-half after 40 hr per week, or for work before 8:00 a.m. and after 5:00 p.m., Monday through Friday.

Perpetual inventory is maintained of parts and tools in the shop and in the mechanics' car stocks. Car stock consists of belts, fuses, filters, refrigerant, refrigerant oil, machine oil and grease, soft copper tubing, solder, sandcloth, and fittings.

As items are removed from car stock or inventory, they are recorded on the work order ticket and on an inventory sheet by the stockman. As parts are delivered to the shop from the supply houses, they are checked against the invoices by the stockman, and these additions to inventory are then recorded on the inventory sheet. This inventory sheet is submitted to the accounting department weekly so that the master inventory record is kept current.

• • •

CONTRACTORS—

[*Concluded from page 86*]

partment of Labor, reported that there are 547 local joint committees for the pipe trades in the country, with 2100 registered apprentices in the program. He commended the holding of graduation ceremonies for apprentices, as they give recognition to the apprentice in his own community.

In one of the resolutions adopted at the final session, manufacturers of baseboard radiation were requested to furnish certified output ratings.

Another resolution approved of the separation of contracts. According to the report of the association's committee on legislation, of which Fred Williams is chairman, separation of mechanical contracts from the general contract is fair and equitable for all concerned because such separation "saves a brokerage fee, increases competition, reduces the risk, provides direct responsibility, tends toward lower bids, assures continuity of work, has been confirmed by experience in several states where separation is required on projects financed by state funds, avoids duplication of inspection, avoids useless or duplicated services of coordination, and avoids the errors of a non-specialist procuring materials and equipment."

Wray M. Scott Elected President

At the concluding session of the convention, Wray M. Scott, of Omaha, was elected president of the HPACCNA, H. E. McGregor, Cambridge, was named vice president, and William W. Murray, Jr., New York City, was chosen treasurer. The new members of the board of directors are Frank Haines, Washington, D. C., R. W. Lawinger, Chicago, Arthur W. Kelley, Cincinnati, E. L. Nattkemper, San Francisco, and Mr. Scott. The new president of the junior association is George W. Spohn, Jr., Akron, the vice president is D. L. McConachie, Detroit, the secretary is William Hoier, Jr., Chicago, and the treasurer is William J. Olvany, Jr., New York. Awards for distinguished service to the association were made to Daniel Hayes (who served as convention chairman) and to Edwin P. Ambler.

Reverse Cycle System Heats and Cools Store

Fig. 1—Bullock's store at Palm Springs is heated and cooled by a reverse cycle or heat pump system. The cooling load is 2½ times the heating load, due to the hot summers and mild winters of the desert location

E. H. GEBHARDT and D. T. DuBAIN, chief engineer and project engineer, respectively, Western Air & Refrigeration, Inc., describe the design and selection of the heat pump system serving Bullock's famous store at Palm Springs, Calif., the year 'round. Balancing the heating and cooling requirements and the method of control to insure economical operation during the various seasons are given special attention

WHEN BULLOCK'S, INC. decided to erect its department store in Palm Springs, Calif. (100 miles southeast of Los Angeles, and a famous desert resort), the possibility of using a reverse cycle (heat pump) air conditioning installation was readily visualized by Walter Wurdeman and Welton Becket, the architects. During the initial phase of design, a study of well water tables near the site revealed that the sinking of a deep well casing with a turbine pump could be economically justified when weighed against the first cost and maintenance expense of separate heating equipment. Tests also indicated a constant water temperature of approximately 68 F the year around, which simplified design since loss of efficiency due to varying heat source temperatures in the winter and condensing water temperatures in the summer could be eliminated from the calculations.

Based upon heating and cooling requirements, a balance was reached at 250 gpm of well water to the condensers during the cooling season with the same amount going through the water chillers during the heating season. To accomplish this, a deep well casing was sunk in the rear of the store to a total depth of 348 ft below the ground surface and 170 ft below water level. The total dynamic head of the well water circuit (containing the most resistance), established at 250 ft (178 ft of this constituted by a 178 ft suction lift), required a 25 hp pump.

Cooling Load 2½ Times Heating Load

Because of the desert location, with hot summers and mild winters, the cooling load was calculated to be approximately 2½ times the heating load (1,820,000 Btu per hr as against 701,000 Btu). Therefore,

the basis of selection necessarily being determined by the largest requirement, three 75 ton reciprocating compressors with interconnected water-cooled condensers and water chillers on the refrigeration cycle were chosen. One system was installed as a complete standby unit to provide greater flexibility to the system.

However, due to the critical power supply in this area, the controls had to be designed so that no more than two compressors could operate at any one time. As a further safeguard and to insure stable operation when two compressors may be on different cycles of operation (heating and cooling), three independent refrigeration piping loops connecting the high and low sides of each compressor-condenser-chiller combination were installed.

The chilled water circulating gpm was based on a 10 deg temperature split across the cooling coils with an economical suction pressure balance between chiller and compressor being based on supplying 370 gpm of 50 F water to the coils, this amount of water to be cooled from 60 to 50 F by the refrigeration plant during peak design conditions.

Determining the Heating Operation

However, an arbitrary temperature split to determine gpm could not be made for the heating cycle. Only after careful study involving the plotting of condenser-compressor balance curves, Fig. 2, could an economical and satisfactory heating cycle operation balance be reached between hot water circulating gpm, water temperature, coil size, and compressor head pressure.

This procedure was necessary in view of the light heating load which indicated that one compressor with half its cylinders unloaded could handle the maximum design requirements. Since the refrigeration compressors used are of the hermetically sealed direct driven type, the amount of heat rejected to the condenser and available for the heating cycle is the net sum of the compressor capacity plus the total heat input to the compressor motor. Therefore, a nominal 75 ton compressor driven by a 75 hp motor would reject in excess of 700,000 Btu per hr with 50 percent of its cylinders unloaded.

Therefore, since gpm and temperature of the water returning from the hot water coils to the refrigeration condenser are functions of the compressor operating head pressure, proper selection of these control points was made so that the compressor could operate at 100 percent capacity and still not exceed its safe operating head pressure.

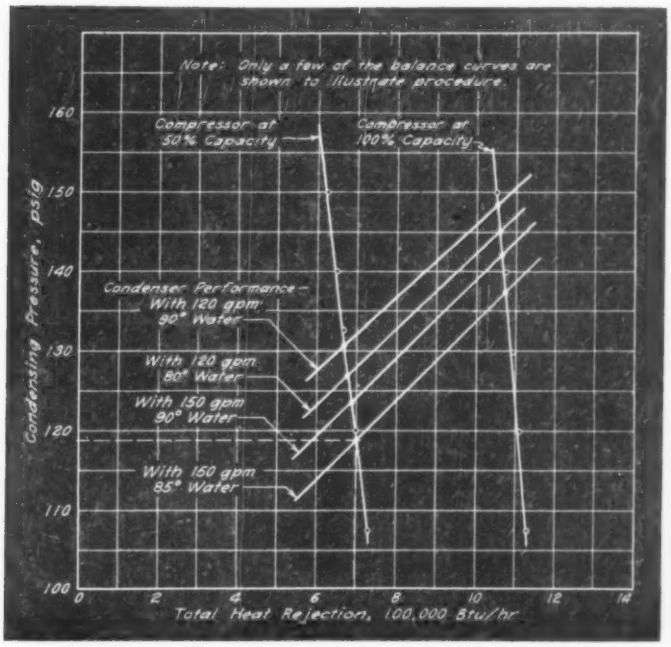
By examination of Fig. 2 and Table 1, it can be seen that the most suitable balance gave control points of 90 deg-95 deg supply water and 150 gpm. At this condition, the compressor could come up to 100 percent capacity on start-up without fear of cutting out on high head pressure. If lower water quantities and higher water temperatures were employed, excessive head pressures would be developed. If lower temperatures and higher water quantities were used, then the horsepower on the hot water circulating pump would have to be increased accordingly.

This analysis and its conclusions formed the basis for selection of the hot water circulating pump capacity and the heating coils. The air quantities having been determined by the internal sensible cooling load, and since it was decided to use the same cfm for heating, it was then possible to work back from desired room temperatures and zone heating loads to determine the necessary zone supply air temperature. With water temperature and gpm having been established, as previously described, the necessary data were available for selection of the heating coils.

Solving the Problem of Control

After the basic equipment selection was made, the problem of control became the subject of considerable discussion. At one time it was decided to make the system completely automatic and to mix well water with chilled water when the temperature in the water sup-

Fig. 2—Compressor-condenser curves. Heating cycle: Design load = 701,000 Btu per hr. Compressor suction temperature balance with 250 gpm of 68 F well water through chiller = 48 F ± @ 50 percent capacity = 43 F ± @ 100 percent capacity. Safe operating head pressure = 148 psig. 150 gpm of 85 F water produces 700,000 Btu per hr @ 119 psig condensing pressure @ 50 percent capacity. This would satisfy heating load. 700,000/150 × 500 = 9 F temperature rise. 85 + 9 = 94 F. Coil selection based on 90 F. Thermostat control points, 90 F to 95 F



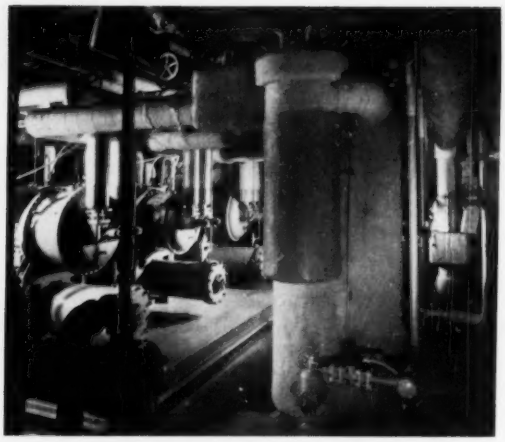


Fig. 3—Three 75 ton compressors, with interconnected water cooled condensers and water chillers on the refrigeration cycle, furnish heating in winter and cooling in summer, water from a well being the source of the heat or the method of its disposal

ply line to the cooling coils fell below a predetermined limit on the cooling cycle and to mix well water again with hot water when the condensing pressure rose above a safe operating limit on the heating cycle.

However, this idea was discarded in favor of keeping the well water circuit completely independent of the closed chilled water and hot water loops—as shown in the schematic water piping diagram, Fig. 4. The reason is to keep any sand or sludge that might carry over in the well water out of the air conditioning heating and cooling coils. Therefore, on the cooling cycle, well water is pumped through the refrigeration condenser (as a condensing medium) and back to the disposal well with a closed circulating loop between the chilled water pump, chiller and cooling coils. On the heating cycle, the well water circuit is through the chiller (as a heat source) and thence back to the disposal well with a closed circulating loop between the hot water pump, refrigeration condenser and heating coils.

The refrigeration control was simplified to some extent by providing manual selection of the cycle desired by means of a five-point drum type program selector switch. The five points consist of (1) one compressor on heating, (2) one compressor on cooling, (3) two compressors on cooling, (4) one compressor on cooling and one compressor on heating, (5) off.

This portion of the control is left to the store engineer's judgment, depending upon weather and store conditions. Selection of a program starts at the same time the appropriate circulating pumps and positions two-way automatic valves on the entering side of the selected chiller and condenser and three-way two-position valves on the leaving side to establish the proper flow of well water and hot or chilled circulating water to produce the cycle desired.

As an illustration, refer to Fig. 4 and assume that the operator has selected program 4, which sets up one compressor to heat and one compressor to cool (which may be the case during cool weather and a high occupancy load in part of the sales area.)

If compressor sequence is set so that compressor No. 2 will start on heating and compressor No. 1 on cooling, then the valves position as follows:

Valve No.	Position
1	Open
2	Closed
3	Open to disposal well and closed to hot water supply line
4	Closed
5	Open
6	Open to hot water supply line and closed to disposal well
10	Open
11	Closed
12	Open to chilled water supply and closed to disposal well
13	Closed
14	Open
15	Open to disposal well and closed to chilled water supply

To summarize, when heating is called for by the program switch, the well water pump starts, the hot water pump starts, and the automatic valves position to put well water through the chiller as a heat source and hot water circulating water through the condenser as a supply to the heating coils. When cooling is demanded, the well water pump starts, the chilled water pump starts, and the automatic valves position to put well water through the condenser as a condensing medium and chilled circulating water through the chiller as a supply to the cooling coils.

The controls are also set up so that the refrigeration compressors will not cut in upon load demands until a definite program has been selected. Also, by means of a drum selector switch, it is possible to select any compressor sequence on the cycle desired to equalize wear on the machines.

The compressors, equipped with 50 percent capacity reduction features for economical operation under light cooling loads and the entire heating range, are controlled by a thermostat in the chilled water supply line on the cooling cycle, and a thermostat in the hot water supply line on the heating cycle, both of which maintain predetermined constant supply temperatures. Power to the compressor starters comes through a series of relay contacts from a multistep controller. These contacts are contained in program and sequence relays which are energized by the program and sequence selector switches to give the cycle and sequence desired. The multistep controllers contain only four steps of operation on the cooling cycle, which means that no more than two compressors can operate on this phase and only two

Table 1—Calculated operating conditions at maximum load conditions. As load decreases, condensing pressure rises due to higher return water temperature. Selection of gpm and water temperature insured that excessive head pressure would not develop at the light load condition

Water quantity, gpm, supply to coils	Temp. of water supply, F	Condensing Pressure, psig, under maximum heating load conditions		Coil depth, rows for same face area	Pump horsepower required
		50% cap.	100% cap.		
120	100	133	152	3+	5
120	90	128	145	5—	5
150	95	119	138	4	7½
150	90	115	130	4	7½
200	90	105	125	4	10

steps of operation on the heating cycle which insures a maximum of one compressor on the heating cycle since there are two steps to each compressor. Therefore, one unit is a complete standby as desired.

Power is also fed through these program and sequence relays to position automatic valves in accordance with the cycle selected by the program switch on the units set up to operate in step by the sequence switch.

The chilled water loop is served by a 10 hp circulating pump, with an equal size as a standby. The hot water loop is served by a 7½ hp hot water pump with standby similar to the chilled water loop. This equipment, together with the refrigeration compressors, condensers and chillers is all located in an equipment room at the north end of the basement.

Suspended Units Save Sales Space

This retail operation, exemplifying the latest in modern architecture, is comprised of two sales floors and a basement totaling approximately 45,000 sq ft of floor space. Because of the value of each square foot of this space in a store of this type, it was decided to use suspended air handling units above the dropped ceiling on the sales floor and exposed suspended units in the basement (since this latter area is primarily a large stockroom and does not warrant the expense of a dropped ceiling.) The first and second floors are divided into four zones each, and the basement into two zones, with an air conditioning unit containing a filter section, coil section and fan section (in that order in the direction of air flow) serving each zone. On the sales floors, the units are above stockrooms or similar areas where slight reverberation noise and comparatively low ceilings are not objectionable.

Each zone temperature is controlled by two thermostats (one for heating and one for cooling) with temperature difference maintained in the setting of these thermostats to prevent over-lapping. On a temperature rise above the setting of the cooling thermostat it functions to operate a three-way bypass valve on the cooling coil of its respective air conditioning unit to supply water to the coil and cut off the bypass. When the temperature is satisfied, chilled water is bypassing the coil. The heating thermostat operates a three-way valve on the heating coil in the same manner, upon temperature drop below the setting.

For each floor, two thermostats have elements in the outside air stream of a selected unit to operate outside and return air dampers of all units on that floor (through interconnected damper motors). Varying outside air temperatures operate these dampers to decrease the load on the units during the peak seasons. A minimum outside air damper opening is maintained for ventilation purposes.

Another feature of the controls is that during the heating cycle, a thermostat on each floor will take control of the dampers to provide outside air sensible cooling prior to a demand for refrigeration when the internal load is high and the outside temperature is below the required room conditions. The space between the ceiling and the overhead slab is utilized as a return air plenum on the first and second floors, pulling air through large return air grilles. The basement units, being exposed, pull air directly through their return air dampers upon outside temperature demand.

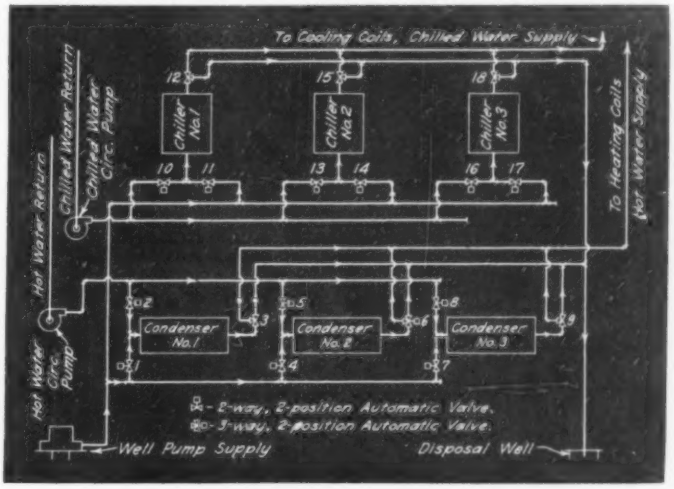
The air handling units deliver a total of approximately 75,000 cfm with a total fan connected horsepower of approximately 50.

Data taken on tests after the plant was put into operation bore out the early convictions of the design engineers. Coefficients of performance, based on the total horsepower input of fans, pumps and compressors range from 3.6 to 4.1 on the cooling cycle and 1.1 to 1.5 on the heating cycle. Without the fans and pumps, the coefficient of performance ranged from 4.5 to 5.3 on the cooling cycle and 5.2 to 5.6 on the heating cycle. Maintenance, always a problem in a resort location, is a factor which indicated the advisability of one set of equipment for both heating and cooling.

The reverse cycle plant has now been in operation for more than two years. During that time there has been only one service call and this merely to change one of the cages on an expansion valve. When the weather was 10 deg below design outside conditions, never more than one compressor was necessary to maintain the desired comfort conditions. The store was kept open during the summer before last when outside temperature rose to 116 F and above. However, comfort conditions of 82 F inside temperature were maintained by the operation of two compressors.

This store was designed by Wurdeman & Becket, architects, Los Angeles, acting as their own structural and mechanical engineers. The general contractor was P. J. Walker Co., Western Air & Refrigeration, Inc., Los Angeles, were the air conditioning contractors.

Fig. 4—Schematic diagram of the water piping for the heating and cooling. Positions of the numbered valves under operating conditions are explained in the text



How Baseboard Radiation Is Used in Tall Buildings

LEWIS SMITH, of C. A. Dunham Co., has been closely connected with and has had a wide experience in the heating of many large building projects. He describes here a new wrinkle in piping for heating systems in multi-story structures where baseboard radiation is used. In the piping method from which the scheme described is adapted, the heating units in a tier of rooms are connected in series on a single riser, steam being fed to the riser at the top with continuous flow to the drip trap at the bottom

TRENDS IN architecture often put the consulting engineer "behind the eight ball" when it comes to designing the heating system. Were the heating industry able to freeze architectural design, as Joshua made the sun stand still, much effort would be spared the engineer. Fortunately, there are enough geniuses in the heating profession not only to solve the problems but in solving them to develop new ideas of benefit to the building industry as a whole.

When the Fordham Hill project of the Equitable Life Assurance Society of the United States was in the design stage in 1947, the architects considered it desirable to use extremely wide windows in the living rooms. This project has nine buildings 15 to 16 stories high, to house 1118 families. It is on high land just north of the Harlem river in New York City, overlooking both the Harlem and Hudson rivers and wide open to the wintry northwest winds.

The 14 ft wide windows are not in themselves so remarkable but when they are used in tall buildings of fireproof construction, with masonry walls and concrete slab floors, the heating situation they present to the consulting engineer proves to be quite unusual.

The solution of the first problem, distribution of heat along the full width of the window, was solved by the use of baseboard units. Such units blanket the entire outside wall with heated air and stop downdrafts, making all parts of the living rooms comfortable in the most severe weather. In addition, it was estimated that with the reduction in temperature difference from floor to ceiling, a feature inherent in baseboard radiation, there would be a reduction of from 10 to 15 percent in the fuel used for heating.

Piping Scheme for Baseboard Units

It was easy to decide on using baseboard units but it was another matter to fit them into this type of construction, as there would be no space for branches from the risers except by hanging them on the ceiling below and furring them in—an expensive procedure.

Nearly 10 years ago, this same owner and consulting engineer had used, at the Clinton Hill project in Brooklyn, what was at that time a relatively new method of piping. With this method, all the heating units in a tier of rooms are connected in series on a single riser, steam being fed into this riser at the top, with continuous flow of steam down the riser to the drip trap at the bottom. The heating effect of the radiation is varied to meet the requirement for heat in the rooms by means of circulating steam at variable vacuums, providing variation in steam temperatures from 215 deg or more down to 133 deg or less. Experience had confirmed the wisdom of using this type of piping and control on this project.

It was realized that this method of piping, applied to Fordham Hill, would overcome the difficulty of riser expansion and eliminate need for branches to the heating units as well as all swing connections.

Several problems presented themselves, however. For use with this method of piping, the heating element of the baseboard unit must have a free area sufficient to keep the total pressure drop in the riser within ½ lb maximum. This apparently required the use of a 1½ in. pipe. But such a pipe meant a rather bulky baseboard with considerable projection into the room. A smaller pipe seemed essential, yet the baseboard unit must have enough capacity so that the required heat can be obtained from the space available along the outside wall without recourse to interior partitions.

No baseboard known to the engineers complied with all these requirements and the design which came closest to filling the bill was made with 1 in. iron pipe on which are mounted 2¾ in. wide fins, the fins being steel or aluminum as required for capacity. The 1 in. pipe, however, was far too small. Some of the rooms require over 50 sq ft EDR, which would mean a riser load for 16 stories of over 800 sq ft, beyond the capacity of a 1 in. pipe.

It then occurred to those interested in the matter that connecting

these baseboard units in parallel or tandem on every two floors would reduce pressure drop due to the 1 in. pipe by 75 percent, because the steam flow in each such pipe is reduced 50 percent and the pressure drop varies as the square of the weight of steam flowing. Even at that, the pressure drop in the entire 16 story riser would remain too high. Hence, it was decided to cut each riser in two. To explain how this was done, it is first necessary to consider the floor layout.

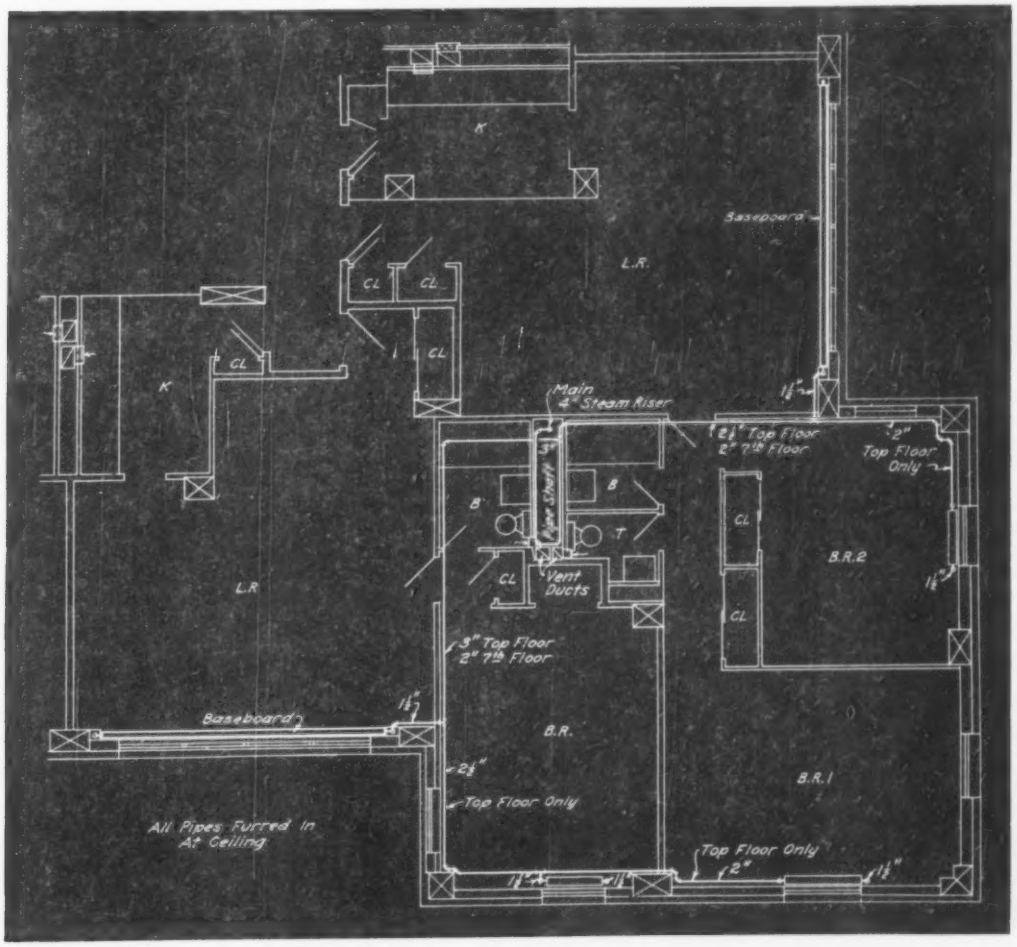
Part of the advantage of this method of piping is to use, wherever possible, bathroom and kitchen heat risers to convey steam to the tops of the downfeed risers. Examination of the floor plan, Fig. 1, at Fordham Hill, shows that kitchens and bathrooms are inside and require little if any heat. In fact, it is the arrangement of the kitchens which makes the extra wide living room windows desirable. Heat risers in the usual sense were therefore eliminated.

Risers in Pipe Spaces Heat Walls

However, the inside bathrooms, having mechanical exhaust, require some small amount of heat. One plan was to hang a steam main at the top floor ceiling along the outside wall to supply not only the downfeed risers but also small bathroom heat risers. A better idea was suggested, however. This scheme was to put the necessary steam risers in the pipe spaces between the bathrooms and leave them bare so that they heat the bathroom walls—which transmit enough heat by radiation and convection to make the bathrooms comfortable at all times. These risers are 4 in. and are anchored in the middle. Since there are no connections to these risers except at the top and bottom, no expansion joints are needed because all expansion is taken up in liberal swing connections. The cold water pipes in these shafts are covered anyway and the ventilating ducts' were sealed off from the shafts, and so are not affected by the added heat.

With this scheme, it is possible to use a number of risers which serve

Fig. 1—Floor plan showing two apartments, one-fourth a floor, at Fordham Hill. Kitchens and bathrooms are inside and require little heat



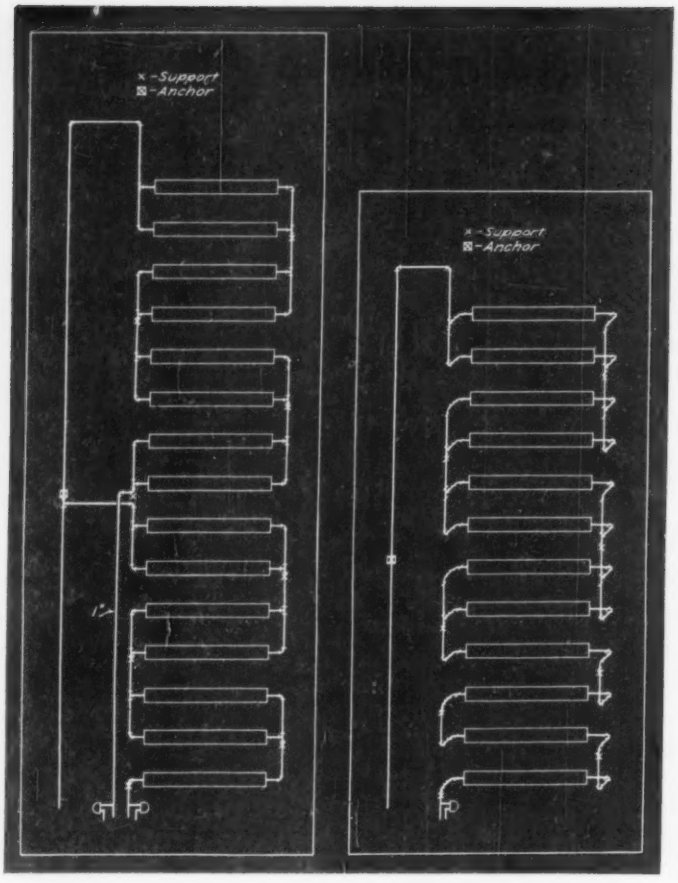


Fig. 2 *(left)*—**Piping layout at Fordham Hill, using 1 in. baseboard. Fig. 3** *(right)*—**The layout at Park Drive Manor, with 1¼ in. baseboard. Vertical risers are 1½ in.**

the triple purposes of feeding all the risers both at the top and in the case of the living rooms at the midpoint, and of heating the bathrooms. In this way a source of steam supply is available at the ceilings of the 7th or 8th floor to feed the living room risers from there down, while the similar risers on the upper floors stop at that floor. All this means a further reduction of the pressure drop of 50 percent and makes possible the use of the 1 in. baseboard pipe.

This riser appears as shown in the sketch of Fig. 2. In order to avoid having a trap at the 8th floor, a 1 in. drip line was dropped straight down to the basement in the furred space alongside the columns and the drip trap located in the basement where it is in the open and easily reached for servicing.

In the bedrooms, wall hung cabinets are used with risers exposed alongside and on alternate sides of the windows. Since these windows are of ordinary width, a short cabinet is used with 1½ in. pipe both for heating elements and risers. The risers are in one run from the 16th floor to the basement without exceeding the allowable pressure drop of ½ lb.

Features of the Piping Layout

There are several things about this scheme of immediate interest to the architect, consulting engineer, builder and heating contractor.

1) Provision for expansion of piping. The longest straight run of riser with baseboard in tandem is three floors or about 26 ft, as—for instance—from the 12th to the 15th floor in Fig. 2. By supporting this riser at the 14th floor, the greatest expansion is downward to the 12th floor, a run of 17 ft producing about 0.2 in. travel, whereas the expansion upward to the 15th floor is but 0.1 in. When installed cold, the baseboard pipes are given as much pitch as possible in the direction of steam flow. The maximum movement could not cause actual backgrading—the steam and condensate flowing in the same direction, it is only necessary that the pipes be flat at worst. Hence, no provision need be made for expansion, with an obvious saving in labor and fittings.

The riser anchor or support is merely a piece of steel tubing around the riser pipe under the flange of the tee and resting on a plate on the floor slab, Fig. 4. Ordinary pipe clamps may be used if space allows inside the furring.

2) Concealment of piping. With the baseboard extending practically the full width of the rooms, the risers run alongside the columns and are furred in. The baseboard enclosure is the full length between plaster faces. To facilitate installation and removal, it was made in two pieces which together are ½ in. shorter than the full length of the recess between columns. A splice plate covers the joint in the middle. Thus, a variation of plus or minus ½ in. is provided to allow for variation in masonry.

3) Clearing the spandrel beams on the Fordham Hill job is accomplished by an offset in the baseboard back and having the pipe off center in the fins, as illustrated in Fig. 5. In this way the baseboard pipe is on the same center line as the riser which in turn clears the spandrel beam.

On a more recent job, Park Drive Manor in Philadelphia, designed in 1949, a variation of the Fordham Hill design is used. Here the buildings are 12 stories and the radiation per room somewhat less. It was calculated that if the baseboard were made with 1¼ in. pipe, the entire load could be carried on a single riser instead of splitting into

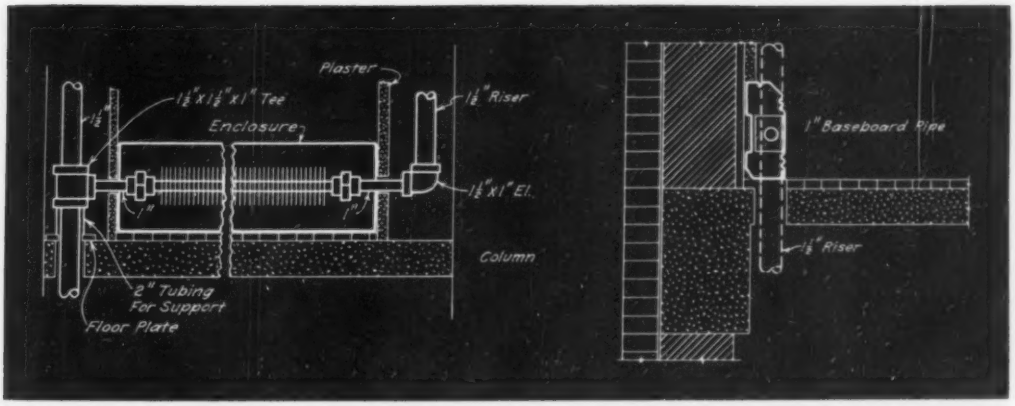


Fig. 4 *(left)*—The riser support is a piece of steel tubing around the pipe under the flange of the tee and resting on a plate on the floor slab. Fig. 5 *(right)*—Clearing the spandrel beams at the Fordham Hill job is accomplished by an offset in the baseboard back and having the pipe off center in the fins

two risers. It was noted also that by offsetting the baseboard at each floor from the riser, the projection into the room could be reduced by ¾ in. This job is therefore being installed as shown in Fig. 3. With the 1¼ in. pipe, the lower few floors —where the steam flow is very small—are connected in series, saving some cost. This method was also adopted at the Queensview project in New York City, now under construction. The arrangement at each floor is shown in Fig. 6.

In all these cases, a support is needed under the middle of the baseboard pipe to keep it from sagging from the weight of the fins. Some of these pipes may be from 10 to 20 ft long, but one or two simple strap iron supports in the center are enough.

Providing Temporary Heat

It should especially be noted that with the baseboard as used on these jobs, the top of the enclosure back serves as a plaster stop. The backs are installed first, before plastering, and then the risers and baseboard elements are connected up so that the permanent installation can be used for temporary heat. This will save the owner and builder the normal cost of temporary heat settings.

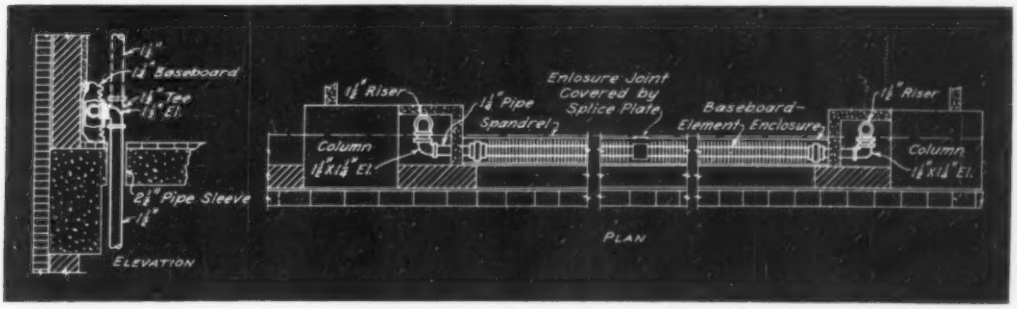
All three projects use baseboard either in the living rooms, as in Fordham Hill and Queensview, or throughout, as at Park Drive Manor, and represent probably the first use of baseboard in tall buildings of 12 to 16 stories. It can safely be said that the method of piping employed makes such use of baseboard possible because no allowance is required for riser expansion at each setting.

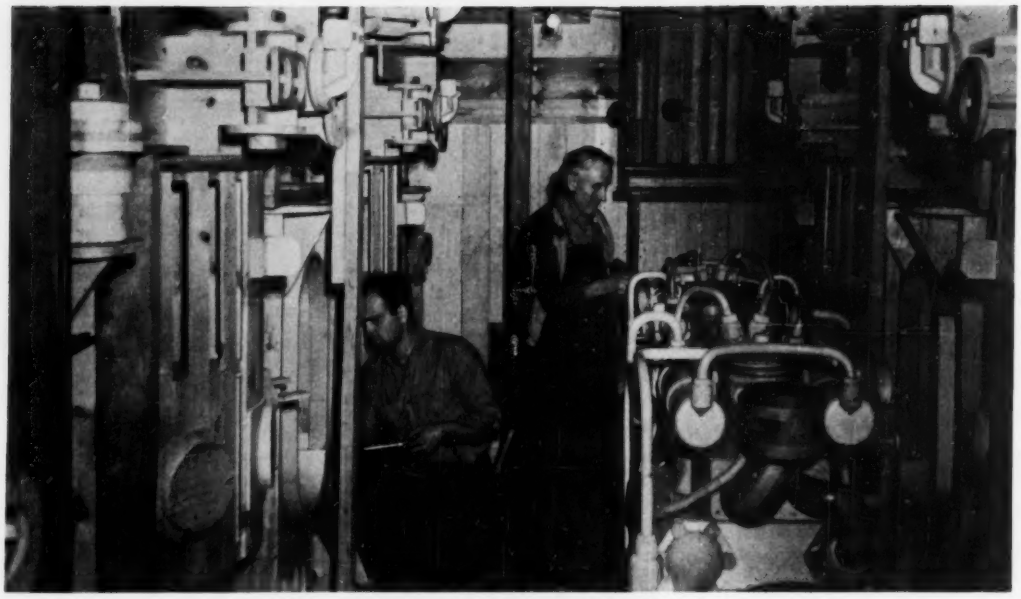
There is a further feature in the use of baseboard which became evident on these projects and must be considered as an item of total building cost rather than heating installation cost alone. It requires only the installation of a wood ground at uniform height along the entire outside wall with no interference with the masonry. The walls are uniform for the whole building, and the plasterer makes a clean sweep with no corners.

Fordham Hill was built by Starrett Bros. & Eken, Inc., for the Equitable Life Assurance Society of the U.S., who will operate the property. The architect was Leonard Schultze and Associates, and Edward E. Ashley was the consulting engineer. The heating installation was by Baker, Smith & Co., Inc., all of New York City.

The heating system at Queensview is being installed by the Raisler Corp. and the Park Drive Manor job at Philadelphia by Benjamin J. Lessner.

Fig. 6 *(below)*—Piping scheme used at Queensview and Park Drive Manor. The joint covered by a splice plate allows for variation in masonry





Two workmen install wooden machinery in the mockup

Wood Mockup Helps Solve PIPING PROBLEMS

HOWARD S. DEWEY, who has had several years of experience as an engineering officer in submarine service, shows how wooden mockups—complete even to the ever-present coffee urn—simplify construction and promote efficiency. Where space usage in any structure must be carefully considered, full-size or scale models of piping and other equipment are often used to advantage

IN THE TURBULENT days of World War I, the shipbuilding manager for the Electric Boat Co., Groton, Conn., contemplated a bite which threatened to become more than he could chew. Committed to short term contracts to supply the infant submarine service with ships, he was having difficulty meeting production schedules. The complex nature of the submarine, with its maze of piping, wiring and electrical equipment, was defeating known shipbuilding production methods used on more prosaic craft. The different trades simply couldn't lay templates, run wiring, install machinery and do all this simultaneously on the same submarine without hindering one another.

To expedite construction, rude wooden replicas of the piping to be installed on submarines had been used. Why not make an entire wooden submarine?, it was suggested. On this mockup, pipefitters —knowing in advance where all obstructions would exist—could route the path of the piping with templates without hindering other workmen busy assembling the hull and machinery. Furthermore, with the templates used as patterns, piping could be mass produced for as many submarines as were being constructed from a single design. The first wooden submarine was therefore built from actual construction blueprints—a full sized mockup.

To eliminate the necessity for making wooden piping, metal piping was installed on the mockup. Later, after other trades had established the position of their machinery or

Model builder at work making wooden valves to be mounted in the wooden submarine

routed their wiring, the piping was removed and re-installed on the submarine for which it was originally intended.

With the ending of World War I, there was an almost complete abandonment of naval appropriations. It wasn't until 1932 that shadows of coming events and the election of a pro-navy president shook submarine construction from its lethargy. The mockup idea was again dusted off. For economy, a compromise decision was reached in which a mockup on a slightly reduced scale was used. Instead of being a complete replica with topside superstructure, this mockup was confined to the more intricate and compact hull and interior compartments. It was built in compartment sections, in the machine shop, where it was squeezed in between the machine tools.

In 1938 the mockup's value in submarine construction was firmly established, and with the expansion of shipyard facilities more room was required in the machine shop. Prompted by these two motives, a four story building to house and meet the specific needs of the mockup and its builders was constructed. A new mockup was constructed to include advanced theories in submarine design. It was built in complete detail and all compartments were connected in sequence from fore to aft.

With the demand for increased production, the mockup began to show its potentialities. Its wooden decks echoed night and day to the tramp of feet. Pipefitters, electricians, metalworkers, draftsmen, engineering designers and the mockup's own personnel joined in a vital effort. With the advantages the mockup offered, prefabricated piping, electrical equipment, machinery foundations and sheet metal work were produced for as many as six boats in advance of actual keel laying.

With the end of World War II, submarine building came to its inevitable halt, and the worn mockup was torn down, its task completed.

L. J. Arnold, in charge of constructing the new mockup, checks a wooden compressor

Orin C. Ford, mockup expert, checks some of the work in the wooden submarine. Note the wooden door to his right and the wooden coffee urn on his left

War teaches its own profession best, and many of the lessons learned in the haste and stress of combat can now be evaluated and the tools of war improved. A new mockup that will serve as a pattern for three new submarines is now being completed, will incorporate improvements learned from World War II underwater warfare. Eighteen model builders will labor 14 months to construct it. The new wooden submarine is carefully attended by select personnel and is closely guarded.

The mockup has developed a trade specialist of its own, for a good model builder must be a combined patternmaker, carpenter, cabinetmaker, and possess the ability to read blueprints. The prints are those received from contractors who supply machinery that is to be installed in the submarine. All of this machinery must be shown by wooden replicas in the mockup. Thus, each presents itself as an obstacle occupying a certain place. Often, these machinery models must be constructed so that they can be dismantled piece by piece—just as the actual machinery would be if it required repairs aboard a submarine.

Every submarine hull is equipped with removable patches through which heavy machinery can be removed or installed. Prior to installation of main engines or motors, their wooden counterparts are lowered through a patch in the mockup and installed. This procedure is carefully observed by subcontractors' representatives and riggers who will install the actual machinery. To drop a 16 ton diesel engine through a narrow opening into a cluttered compartment and carefully align it on its foundation, is a trick that calls for the afternoon off. Preliminary practice with a wooden engine on the mockup has eliminated much of the trial and error.

The forests of New Hampshire supply most of the white pine, spruce, and fir that go into the mockup construction. This wood is pre-dried prior to use. Each type serves certain purposes—spruce because of its pliability is used on the barrel-shaped hull, white pine is used for interior machinery and fixtures (such as tables and chairs), fir is used in the deck and for the cradle which supports the mockup in an upright position. To eliminate distortion, the cradle forms a protecting arc around the major portion of the hull.

Because wood does not possess steel's strength, frames on the mockup are larger than on its steel mate. The steel frame actual width is marked in blue pencil on the wooden frame and that part of the wood not taken into consideration when measuring distances from frame to a desired point is called "dead wood". When repeated markings become confusing the frames are painted white and new markings are coated with protecting clear shellac.

This additional width in the mockup's cross frames causes it to be egg shaped, the only dimensional variation in the model. Plywood is being used extensively in the new mockup, because of its resistance to distortion. To show electrical wiring taxed the model builders' ingenuity. An enterprising electrician, impatient with progress, brought along a discarded garden hose one day and since then it has become standard practice. In the case of cables of greater diameter, manila rope, discarded by ships renewing their hawsers, is used.

It costs around $230,000 to construct a mockup. This is eventually saved if two or more submarines are patterned from it. It has been estimated that through economy measures created by the mockup, $130,000 is saved in construction of a single submarine. This represents about 2 percent of the total cost of a submarine.

CHEYENNE SCHOOL HAS RADIANT HEATING

THE HEADER piping for the radiant heating system embedded in the concrete floor slab of the modern Cole elementary school in Cheyenne not only supplies the individual room coils but heats the corridor as well.

The installation utilizes approximately 10,000 ft of 1¼ in., 3000 ft of 1½ in., and some 3, 2, and ¾ in. wrought iron pipe.

PRINCIPLES OF AIR CONDITIONING

WILLIS H. CARRIER, chairman emeritus of the board, Carrier Corp., and honorary member, life member and presidential member of the American Society of Heating and Ventilating Engineers, prepared (with the assistance of a committee appointed by the ASHVE) and presented at the 1929 World Engineering Congress at Tokyo an extensive paper on air conditioning for process and comfort which was published in the November 1929 issue of HPAC. Because of its importance and its thorough treatment of the subject, HPAC's editors recently asked Dr. Carrier to bring it up to date for publication now that "air conditioning has come of age." . . . The first part appeared in the April issue; publication will be completed in following months

IN COOLING AND dehumidifying air, it is necessary to take into consideration not only the sensible heat of the air itself but the latent heat of the moisture removed.

Air at any temperature and moisture content may be considered as having a certain definite enthalpy in thermal units per unit weight as calculated from some arbitrary base such as zero moisture and zero degrees Fahrenheit (F) temperature. By using the psychrometric chart, on which are given wet bulb temperatures and corresponding enthalpies, it is possible to calculate the heat to be removed in the process of dehumidification by subtracting the enthalpy of the cooled air with its reduced moisture content from that of the air in its initial condition as indicated on the chart. This process is greatly simplified by taking into account the fourth psychrometric principle; in other words, in observing the fact that the wet bulb temperature of the air may be used as the measure of the heat which the air contains. Thus, by referring to the chart, having given air of known temperature and known moisture content, a corresponding wet bulb temperature is obtained. Then, under standard barometric conditions, the enthalpy at saturation is determined from the chart. For example, air at 85 F with 80 percent relative humidity has approximately the same enthalpy as air at 101 F and 40 percent relative humidity, because in both cases the wet bulb temperature is 80 F. This wet bulb temperature represents about the maximum wet bulb temperature ever encountered in the temperate zones under extreme conditions, and is nearly the maximum found in the tropics. A normal high wet bulb temperature for the temperate zone may be taken at 75 F in calculating requirements for air cooling, as this is seldom exceeded except for short periods.

Dew Point and Relative Humidity

A peculiar relationship between the dew point and the relative humidity is found most useful in air conditioning work; namely, that for a fixed relative humidity there is substantially a constant difference between the dew point and the dry bulb temperature over a considerable temperature range. The following table giving the room temperature, dew point temperature, and dew point differentials for 50 percent relative humidity illustrates this relationship most clearly:

Dry bulb temperature	65	70	75	80	85	90
Dew point temperature	45.8	50.5	55.25	59.75	64.25	68.75
Difference between dew point and dry bulb temperature	19.2	19.5	19.75	20.25	20.75	21.25

It will be seen from an inspection of this table that the difference between the dew point temperature and the room temperature is approximately 20 F throughout this range of dry bulb temperatures or, to be more exact, the differential increases only 10 percent for a range of practically 25 F.

This principle holds true for other humidities and is due to the fact that the pressure of the water vapor practically doubles for every 20 F through this range.

The approximate relative humidity for any difference between dew point and dry bulb temperature may be expressed as:

$$100/2^{[(t-t_1)/20]}$$

where t = dry bulb temperature and t_1 = dew point temperature.

This principle is very useful in determining the available cooling effect obtainable by the use of ventilation with saturated air when a desired relative humidity is to be maintained in a room even though there may be a wide variation in room temperature. This problem is one that applies to certain industrial applications, such as those in cotton mills, tobacco factories, etc., where relatively high humidities are carried and where one of the principal problems is to remove the heat generated by the machinery. It also permits the use of a differential thermostat, responsive to both the room temperature and the dew point temperature, to control the relative humidity in the room (see reference No. 2).

Rate of Evaporation

In problems of air conditioning and drying, as well as in other industrial applications of evaporation

PSYCHROMETRIC CHART Normal Temperatures

Barometric Pressure
29.92 inches of Mercury

ADDITIVE CORRECTIONS FOR W, h, AND v WHEN BAROMETRIC PRESSURE DIFFERS FROM STANDARD BAROMETER

Wet Bulb Temp.	Sat. Vapor Press.	APPROXIMATE ALTITUDE IN FEET											
		−900		900		1800		2700		3600		4800		5900	
		$\Delta p = +1$		$\Delta p = -1$		$\Delta p = -2$		$\Delta p = -3$		$\Delta p = -4$		$\Delta p = -5$		$\Delta p = -6$	
t'	In. Hg	ΔW_1	Δh	ΔW_1	Δh	ΔW_1	Δh	ΔW_1	Δh	ΔW_1	Δh	ΔW_1	Δh	ΔW_1	Δh
20	.1027	−0.5	−0.08	0.5	0.08	1.1	0.17	1.7	0.26	2.3	0.36	3.0	0.46	3.8	0.58
21	.1078	−0.5	−0.08	0.5	0.08	1.1	0.17	1.8	0.27	2.4	0.37	3.2	0.49	4.0	0.61
22	.1130	−0.5	−0.08	0.5	0.09	1.2	0.18	1.9	0.28	2.6	0.40	3.4	0.52	4.2	0.64
23	.1186	−0.6	−0.09	0.6	0.09	1.3	0.19	2.0	0.30	2.7	0.41	3.6	0.55	4.4	0.67
24	.1243	−0.6	−0.09	0.6	0.10	1.3	0.20	2.1	0.32	2.8	0.43	3.7	0.57	4.6	0.71
25	.1303	−0.6	−0.10	0.7	0.10	1.4	0.21	2.2	0.33	3.0	0.46	3.9	0.60	4.9	0.75
26	.1366	−0.7	−0.10	0.7	0.11	1.4	0.22	2.3	0.35	3.1	0.48	4.1	0.63	5.1	0.78
27	.1431	−0.7	−0.11	0.7	0.11	1.5	0.23	2.4	0.37	3.2	0.50	4.3	0.66	5.4	0.83
28	.1500	−0.7	−0.11	0.8	0.12	1.6	0.24	2.5	0.38	3.4	0.52	4.5	0.69	5.6	0.86
29	.1571	−0.8	−0.12	0.8	0.12	1.7	0.26	2.6	0.40	3.6	0.55	4.7	0.72	5.8	0.89
30	.1645	−0.8	−0.12	0.8	0.13	1.7	0.27	2.7	0.42	3.8	0.58	4.9	0.75	6.1	0.92
31	.1723	−0.8	−0.13	0.9	0.13	1.8	0.28	2.8	0.44	3.9	0.60	5.1	0.78	6.3	0.95
32	.1803	−0.9	−0.13	0.9	0.14	1.9	0.29	3.0	0.45	4.1	0.63	5.3	0.82	6.6	1.01
33	.1878	−0.9	−0.14	1.0	0.15	2.0	0.30	3.1	0.47	4.3	0.66	5.5	0.85	6.9	1.06
34	.1955	−0.9	−0.14	1.0	0.15	2.1	0.32	3.2	0.49	4.4	0.68	5.7	0.88	7.2	1.11
35	.2034	−1.0	−0.15	1.0	0.16	2.1	0.33	3.4	0.51	4.6	0.71	6.0	0.92	7.5	1.16
36	.2117	−1.0	−0.15	1.1	0.17	2.2	0.35	3.5	0.53	4.8	0.74	6.2	0.96	7.8	1.20
37	.2202	−1.0	−0.16	1.1	0.17	2.3	0.36	3.6	0.56	5.0	0.77	6.5	1.00	8.1	1.25
38	.2290	−1.1	−0.17	1.2	0.18	2.4	0.37	3.8	0.58	5.2	0.80	6.8	1.05	8.4	1.30
39	.2382	−1.1	−0.18	1.2	0.19	2.5	0.39	3.9	0.61	5.5	0.85	7.0	1.09	8.8	1.36
40	.2477	−1.2	−0.18	1.3	0.20	2.6	0.41	4.1	0.63	5.7	0.88	7.4	1.14	9.2	1.42
41	.2575	−1.2	−0.19	1.3	0.20	2.7	0.42	4.3	0.66	5.9	0.91	7.7	1.19	9.6	1.48
42	.2678	−1.2	−0.20	1.4	0.21	2.8	0.44	4.4	0.69	6.1	0.94	8.0	1.23	10.0	1.54
43	.2781	−1.3	−0.21	1.4	0.22	3.0	0.45	4.6	0.71	6.4	0.99	8.4	1.29	10.4	1.61
44	.2890	−1.4	−0.22	1.5	0.23	3.1	0.47	4.8	0.74	6.7	1.04	8.7	1.34	10.8	1.67
45	.3002	−1.4	−0.22	1.6	0.24	3.2	0.49	5.0	0.77	6.9	1.07	9.1	1.40	11.3	1.75
46	.3119	−1.5	−0.23	1.6	0.25	3.3	0.51	5.2	0.80	7.2	1.11	9.4	1.45	11.7	1.81
47	.3239	−1.5	−0.24	1.7	0.26	3.4	0.53	5.4	0.84	7.5	1.16	9.8	1.52	12.1	1.87
48	.3363	−1.6	−0.25	1.8	0.27	3.6	0.56	5.6	0.87	7.8	1.21	10.2	1.58	12.6	1.95
49	.3491	−1.7	−0.26	1.8	0.28	3.9	0.58	5.8	0.90	8.1	1.25	10.5	1.63	13.1	2.03
50	.3624	−1.7	−0.27	1.9	0.29	3.9	0.60	6.1	0.94	8.4	1.30	10.9	1.69	13.6	2.11
51	.3761	−1.8	−0.28	2.0	0.30	4.0	0.63	6.3	0.97	8.7	1.35	11.3	1.75	14.1	2.18
52	.3903	−1.9	−0.29	2.0	0.32	4.2	0.65	6.5	1.01	9.0	1.40	11.8	1.83	14.7	2.28
53	.4049	−2.0	−0.30	2.1	0.33	4.3	0.68	6.7	1.05	9.3	1.44	12.2	1.89	15.2	2.36
54	.4200	−2.0	−0.31	2.2	0.34	4.5	0.70	7.0	1.09	9.7	1.50	12.7	1.97	15.8	2.45
55	.4356	−2.1	−0.32	2.3	0.35	4.7	0.73	7.3	1.13	10.1	1.57	13.2	2.05	16.4	2.54
56	.4518	−2.2	−0.34	2.3	0.37	4.9	0.76	7.6	1.18	10.5	1.63	13.7	2.13	17.1	2.66
57	.4684	−2.3	−0.35	2.4	0.37	5.1	0.79	7.9	1.22	10.9	1.69	14.2	2.21	17.7	2.75
58	.4856	−2.3	−0.37	2.5	0.39	5.3	0.82	8.2	1.27	11.3	1.76	14.7	2.28	18.4	2.86
59	.5033	−2.4	−0.38	2.6	0.41	5.4	0.85	8.5	1.32	11.7	1.82	15.3	2.38	19.1	2.97
60	.5216	−2.5	−0.40	2.7	0.42	5.7	0.88	8.8	1.37	12.2	1.90	15.9	2.47	19.9	3.09
61	.5403	−2.6	−0.42	2.8	0.44	5.9	0.92	9.2	1.43	12.7	1.98	16.5	2.57	20.7	3.22
62	.5599	−2.7	−0.43	2.9	0.46	6.1	0.95	9.5	1.48	13.2	2.05	17.1	2.66	21.4	3.33
63	.5800	−2.8	−0.44	3.0	0.48	6.3	0.98	9.9	1.54	13.7	2.13	17.7	2.76	22.3	3.47
64	.6007	−2.9	−0.46	3.2	0.49	6.5	1.02	10.2	1.59	14.2	2.21	18.4	2.87	23.1	3.60
65	.6221	−3.1	−0.48	3.3	0.51	6.8	1.06	10.6	1.65	14.7	2.29	19.1	2.98	23.9	3.73
66	.6441	−3.2	−0.50	3.4	0.53	7.1	1.10	11.0	1.72	15.3	2.38	19.8	3.09	24.8	3.87
67	.6668	−3.3	−0.52	3.5	0.55	7.3	1.14	11.4	1.78	15.8	2.47	20.5	3.20	25.7	4.01
68	.6902	−3.4	−0.53	3.7	0.57	7.6	1.18	11.8	1.84	16.4	2.56	21.3	3.32	26.7	4.16
69	.7143	−3.5	−0.55	3.8	0.59	7.9	1.23	12.3	1.90	17.0	2.65	22.1	3.45	27.7	4.32
70	.7392	−3.7	−0.57	3.9	0.61	8.1	1.27	12.7	1.98	17.6	2.75	22.9	3.58	28.7	4.48
71	.7648	−3.8	−0.59	4.1	0.64	8.6	1.32	13.1	2.05	18.2	2.84	23.7	3.70	29.7	4.64
72	.7913	−3.9	−0.61	4.2	0.66	8.7	1.36	13.6	2.13	18.8	2.94	24.6	3.84	30.7	4.82
73	.8183	−4.1	−0.63	4.4	0.69	9.0	1.41	14.1	2.20	19.5	3.05	25.5	3.98	31.9	4.99
74	.8463	−4.2	−0.66	4.6	0.71	9.4	1.46	14.6	2.28	20.2	3.16	26.4	4.14	33.1	5.18
75	.8750	−4.4	−0.68	4.7	0.74	9.7	1.52	15.1	2.36	20.9	3.27	27.4	4.28	34.3	5.37
76	.9047	−4.5	−0.71	4.9	0.77	10.0	1.57	15.7	2.46	21.7	3.39	28.4	4.42	35.5	5.56
77	.9352	−4.7	−0.73	5.1	0.79	10.4	1.63	16.3	2.55	22.5	3.52	29.4	4.61	36.9	5.77
78	.9667	−4.9	−0.76	5.2	0.82	10.8	1.69	16.9	2.65	23.3	3.65	30.5	4.77	38.2	5.98
79	.9990	−5.0	−0.79	5.4	0.85	11.2	1.75	17.5	2.74	24.2	3.79	31.6	4.95	39.6	6.20
80	1.032	−5.2	−0.82	5.6	0.88	11.6	1.82	18.1	2.84	25.1	3.93	32.7	5.13	41.0	6.43
81	1.067	−5.4	−0.85	5.8	0.91	12.0	1.88	18.8	2.95	26.0	4.08	33.9	5.32	42.5	6.66
82	1.102	−5.6	−0.88	6.0	0.94	12.5	1.96	19.5	3.06	27.0	4.24	35.1	5.51	44.0	6.90
83	1.138	−5.8	−0.91	6.2	0.97	12.9	2.02	20.2	3.17	28.0	4.39	36.4	5.71	45.6	7.15
84	1.175	−6.0	−0.94	6.4	1.00	13.3	2.10	20.9	3.28	28.9	4.56	37.7	5.92	47.2	7.41

t = Dry bulb temperature (F)
t' = Wet bulb temperature (F)
p = Barometric pressure (in. of Hg)
Δp = Pressure difference from standard barometer (in. of Hg)
W = Moisture content of air (gr per lb of dry air)
W_s = Moisture content of air saturated at wet bulb temperature t' (gr per lb of dry air)
ΔW = Moisture content correction of air when barometric pressure differs from standard barometer (gr per lb of dry air)
ΔW_1 = Moisture content correction of air saturated at wet bulb temperature when barometric pressure differs from standard barometer (gr per lb of dry air)

NOTE: To obtain ΔW_1 reduce ΔW_1 by 1% where t − t' = 24 F

Correct proportionally, when t − t' is other than 24 F

h = Enthalpy of moist air (Btu per lb of dry air)
Δh = Enthalpy correction, for saturated or unsaturated air, when barometric pressure differs from standard (Btu per lb of dry air)
v = Volume of moist air (cu ft per lb of dry air)

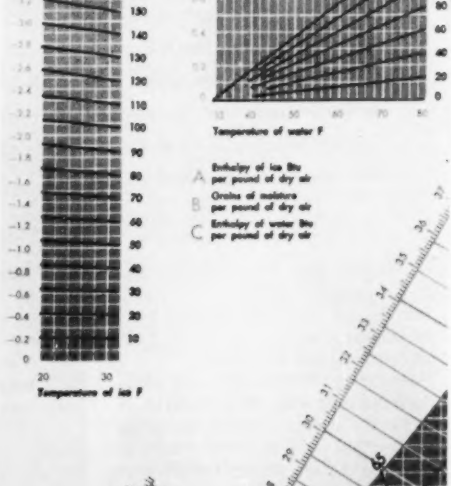
$$v = \frac{.754\,(t + 459.7)}{p}\left[1 + \frac{W}{4360}\right]$$

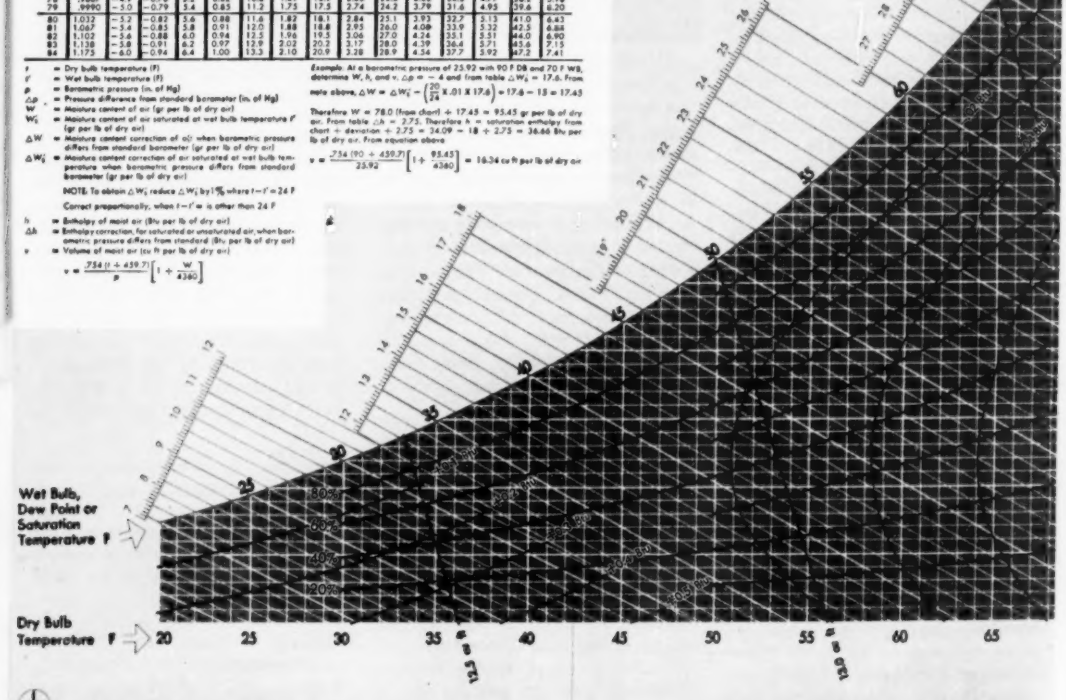
Example: At a barometric pressure of 25.92 with 90 F DB and 70 F WB, determine W, h, and v. $\Delta p = -4$ and from table $\Delta W_1 = 17.6$. From note above, $\Delta W = \Delta W_1 - \left(\frac{20}{24} \times .01 \times 17.6\right) = 17.6 - 15 = 17.45$

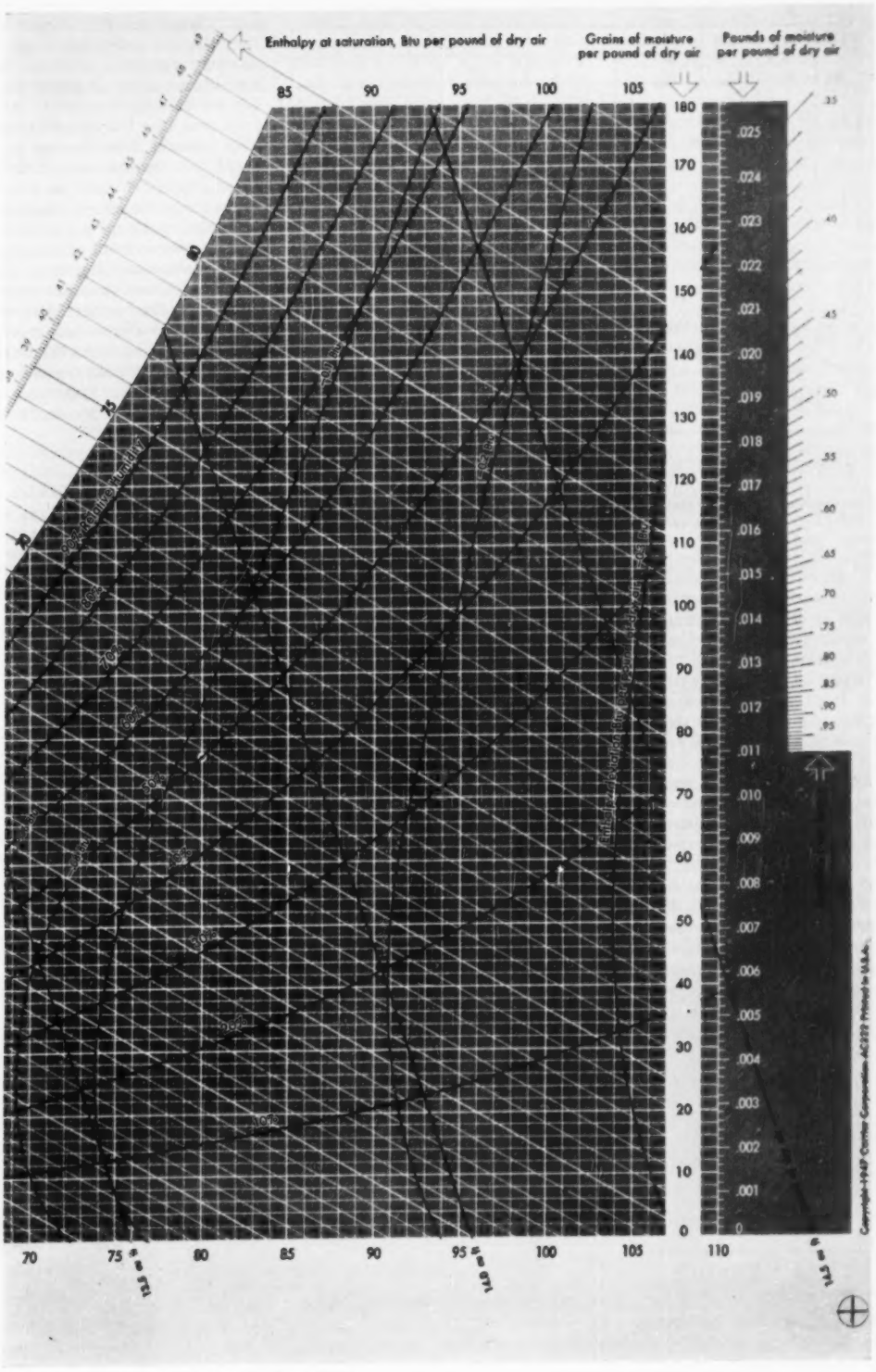
Therefore W = 78.0 (from chart) + 17.45 = 95.45 gr per lb of dry air. From table $\Delta h = 2.75$. Therefore h = saturation enthalpy from chart + deviation + 2.75 = 34.09 − 18 + 2.75 = 36.86 Btu per lb of dry air. From equation above

$$v = \frac{.754\,(90 + 459.7)}{25.92}\left[1 + \frac{95.45}{4360}\right] = 16.34 \text{ cu ft per lb of dry air}$$

ENTHALPY OF ADDED OR REJECTED MOISTURE


A
B
C
Temperature of ice F
Temperature of water F
Enthalpy of ice Btu per pound of dry air
Grains of moisture per pound of dry air
Enthalpy of water Btu per pound of dry air




Enthalpy at saturation, Btu per pound of dry air
Grains of moisture per pound of dry air
Pounds of moisture per pound of dry air
85
90
95
100
105
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
.025
.024
.023
.022
.021
.020
.019
.018
.017
.016
.015
.014
.013
.012
.011
.010
.009
.008
.007
.006
.005
.004
.003
.002
.001
0
.35
.40
.45
.50
.55
.60
.65
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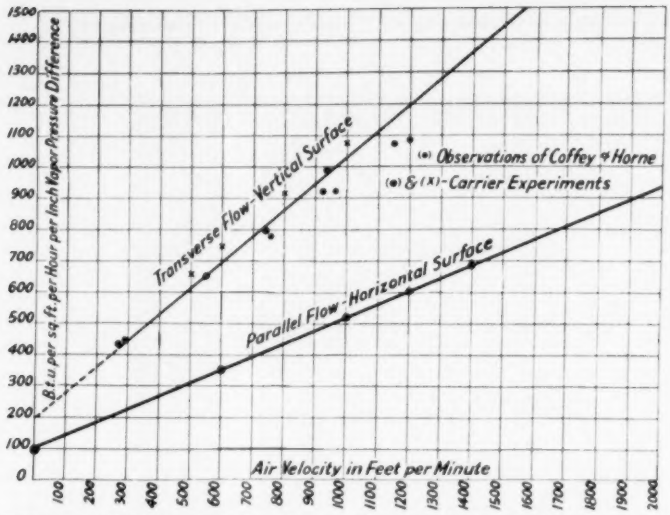
.75
.80
.85
.90
.95
70
75
80
85
90
95
100
105
110


Btu per sq. ft. per Hour per Inch Vapor Pressure Difference
Air Velocity in Feet per Minute
Transverse Flow - Vertical Surface
Parallel Flow - Horizontal Surface
(•) Observations of Coffey & Horne
(•) & (X) - Carrier Experiments

Heat transmitted by evaporation. The equation for the transverse flow curve is $H = 200\ [1 + (v/240)]\ [e—e']$ and for the parallel flow curve is $H = 97\ [1 + (v/230)]\ [e—e']$

(such as cooling towers, for example) it is desirable to determine the rate of evaporation. There are two distinct cases of evaporation. The *first* case is that in which the source of heat is primarily from the water itself and air temperature may even be raised. The *second* is that in which the heat for evaporation is obtained entirely from the air itself, in which case the air is cooled and the temperature of the water remains substantially constant at the wet bulb temperature. Both cases, however, may be reduced to a common basis of calculation. It has been found that the increase in the rate of evaporation is nearly in direct proportion to the increase in air velocity, and that it is in direct proportion to the difference in vapor pressure between the vapor pressure of the water and the pressure of the vapor in the air.

The general formula (see reference No. 3) covering the experimental data may be expressed as follows:

$$\frac{dw}{dt} = (a + bv)\ (e' - e)$$

where dw/dt = rate of evaporation; a = the rate of evaporation in still air; b = the rate of increase with velocity; e' = the vapor pressure of the liquid; e = the vapor pressure in the atmosphere; v = velocity.

The only difference between case *one* and case *two* is that in case *one* the vapor pressure of the liquid is one of the known or assumed factors, being dependent upon the known temperature of the liquid, while in case *two* e' is the vapor pressure corresponding to the wet bulb temperature of the air.

This wet bulb or evaporation temperature is dependent upon the dry bulb temperature and the moisture content, or upon the total heat of the air as indicated in the previous paragraph.

The effect of air velocity depends upon whether the flow of air is parallel to the surface or perpendicular to the surface elements. For a flow of air parallel to a horizontal surface

$$w = 0.093 \left[1 - \frac{v}{230} \right] \left[e' - e \right]$$

(approximate) where w = pounds evaporated per sq ft per hr; v = velocity of atmosphere over surfaces in feet per minute; e' = vapor pressure of the water corresponding to its temperature; e = vapor pressure in the surrounding atmosphere.

For transverse flow, as across a tubular surface, the rate of evaporation is nearly doubled.

These relationships are indicated graphically on the chart for heat transmitted by evaporation (see reference No. 4).

Since the difference in vapor pressures is substantially proportional to the difference between the wet bulb and dry bulb temperatures (i.e., the wet bulb depression) the rate of evaporation is also for case *two* substantially proportionate to the wet bulb depression.

In case *two*, the rate of sensible heat transfer from the air to the liquid to produce evaporation is substantially the same as the rate of heat transfer with the same type of surface without moisture being present, but with the same temperature differences. In other words, the rate of heat transfer depends upon the temperature difference only, whether the surface is wet or not. For example, it has been shown that the rate of heat transfer with air flowing across staggered coils may be represented by the formula (see reference No. 2):

$$U = \frac{1}{0.0447 + \frac{50.66}{v}}$$

where U = Btu per hr per sq ft per deg difference in temperature as experimentally determined from tests on heater coils. At 400 velocity, $U = 5.8$, and at 800 velocity $U = 9.3$

Referring to the chart showing the Btu transfer in evaporation for different air velocities and transverse flow, it will be noted that there is 530 Btu per sq ft per hr transferred by evaporation per inch difference of vapor pressure at 400 velocity, and 910 Btu at 850 velocity.

It has been pointed out that 1 in. of vapor pressure difference corresponds approximately to 95 F difference between the wet bulb and dry bulb temperature. Dividing by 95, the value of 5.7 Btu per sq ft per degree difference in temperature is obtained for 400 velocity and 9.55 Btu per sq ft for 850 velocity.

It will be noted that for these two cases the heat transfer by evaporation per degree difference in temperature corresponds almost exactly to the heat transfer by convection coils. The similarity may be noted by comparing the formula (see reference No. 5) for heat transfer in parallel flow where

$$U = \frac{1}{0.026 + \frac{161}{v}}$$

with the heat transfer in evaporation with parallel flow. The relationship will be seen to be very close in both cases and would indicate that the heat transfer in evapora-

tion is actually brought about by a process of convection.

The difference of the formulas may be due to errors in observation at the higher and lower velocities.

In cooling air and condensing out the moisture therefrom, the heat transfer is considerably more rapid than when the air is dry and no moisture is condensed. In general, the rate of heat transmission on the air side is increased an amount which is proportionate to the latent heat removed as compared with the sensible heat removed. That is, if the latent heat removed was 50 percent of the sensible heat removed, then the conductivity of the surface in contact with the air would be increased approximately 50 percent.

A comparison of the foregoing principles with present-day practice shows that there has been but little change in the theory of air conditioning. Perhaps the chief refinements have been in the graphical representation of these principles—that is, the psychrometric charts and data. The newer charts do provide more complete and precise data over a wider range of conditions than was previously possible. This is due largely to improved steam tables, more accurate specific heat values, improved experimental equipment, and more complete psychrometric research, as well as ingenious chart arrangements. However, despite these improvements, the Carrier chart of 1911 may still be used with sufficient accuracy for normal comfort cooling calculations—the error in heat change per pound of dry air being within the limits of 2 percent.

Until 1946 no satisfactory charts had been constructed to show enthalpy of moist air in its saturated and unsaturated states. Lines of constant enthalpy run so nearly parallel to the wet bulb lines that a chart showing them would be difficult to read. However, a chart published in 1947 achieved the desired result by showing contours of the deviation from the value of enthalpy at saturation. These deviation contours enable the exact determination of the enthalpy of unsaturated air by subtracting (or adding at certain conditions) the deviation from the saturated air enthalpy at the same wet bulb.

Steps showing the evolution of the "enthalpy deviation" appear in an accompanying diagram which compares charts in use since 1923 from this viewpoint. As indicated in this figure, these deviations are slight, especially within the range normally used for comfort cooling calculations and where enthalpy differences are used rather than total enthalpy values.

Those using psychrometric charts for calculations requiring laboratory accuracy and for certain low temperature applications will find the deviation line especially useful; others using them for normal engineering applications can quickly determine whether the enthalpy deviation is of sufficient magnitude to be considered. Those teaching psychrometric principles will now find the explanation of enthalpy at unsaturated conditions greatly simplified.

Diagram showing comparison of Carrier psychrometric data since 1923

Thus, the modern psychrometric chart is perhaps the most useful tool for applying the principles developed almost 40 years ago. It is now possible to:

1) Provide accurate values of enthalpy and moisture content for saturated or unsaturated air by the addition of deviation contours and barometric correction tables.

2) Quickly obtain the enthalpy of make-up or rejected water and ice, so that these often neglected items may be included with little effort.

3) Use deviation lines when high accuracy is desired.

4) Use the new chart with the same facility as former charts when approximate results are acceptable. (The deviation contours together with the diagrams mentioned in Item 2, indicate at a glance the magnitude of error when the approximate method is used.)

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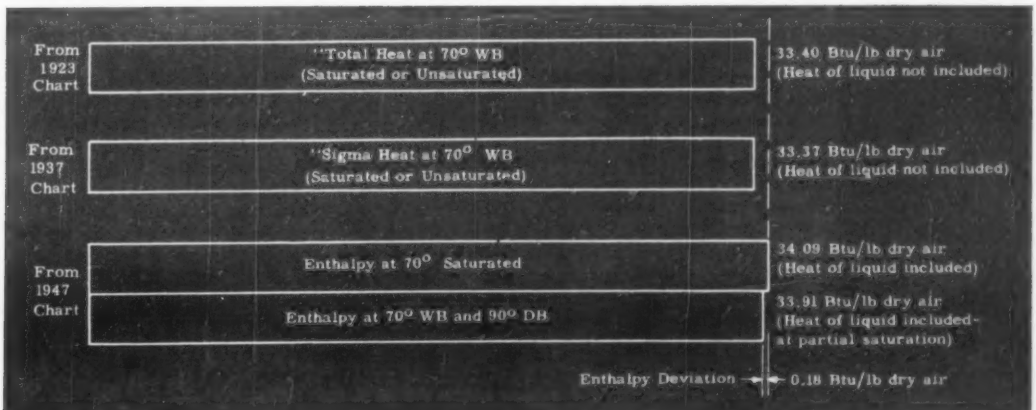
From 1923 Chart
"Total Heat at 70° WB (Saturated or Unsaturated)
33.40 Btu/lb dry air (Heat of liquid not included)
From 1937 Chart
"Sigma Heat at 70° WB (Saturated or Unsaturated)
33.37 Btu/lb dry air (Heat of liquid not included)
From 1947 Chart
Enthalpy at 70° Saturated
34.09 Btu/lb dry air (Heat of liquid included)
Enthalpy at 70° WB and 90° DB
33.91 Btu/lb dry air (Heat of liquid included-at partial saturation)
Enthalpy Deviation
0.18 Btu/lb dry air

Sam Lewis's Page

INFORMAL COMMENT on heating, piping and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer, and a member of HPAC's board of consulting and contributing editors. Suggested topics for comment and suitable questions are welcomed by Mr. Lewis from readers of his "Page." They may be addressed to the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, for forwarding to him.

Permissible Lifts in Vacuum Return Mains

I AM HAVING some fun with friends who take very seriously the increasing number of state laws that call for registration of professional engineers. There seems to be general propaganda that such registration of heating and ventilating and steam piping designers will save lives and money and will promote the health of the public.

In compliance with such a law, long ago I presented myself at a state capital for examination, and I carry a pocket full of annually renewed state licenses—some the result of examination and some by the good and generous old grandfather provision.

I have not learned that the licenses did or do anything whatever for me. They do not educate me nor do they reduce competition. Perhaps they protect the public in some obscure way. Of course, I have no competition as a consulting engineer anyway, because all of us in the fraternity build better mousetraps, all of us know what it costs to apply mechanical equipment to buildings, and not one of us ever retired with a fortune.

Mr. Lewis welcomes suggestions from readers of his "Page" for topics for discussion here

I feel better after having surveyed the long row of license certificates on my office wall, but my diatribe is inspired by a threat of his competitors to apply the penalties in a certain state registration law against a salesman of steam specialties, who in the ardor of trying to earn enough commissions to support his fair young wife, has been designing heating and ventilating systems without ostensible compensation, for architects who evidently do not receive enough money to allow their consciences to pay unattached designers some identified dollars.

It is generally true that things we obtain for nothing either are unappreciated by humans or may be of little value.

Pitch Mains Toward Pump?

In this case, the young salesman furnished what probably was competent engineering advice and hoped to sell several hundred dollars worth of his particular equipment by convincing the architect that this equipment would work only if the vacuum return mains have "a pitch toward the pump of ½ in. or more per every 15 ft of pipe length".

Presumably this stipulation, insisted upon by the architect, would limit the make of vacuum pump to only a kind that had its inlet (regardless of the concomitant features) very close to the floor. If any other make of vacuum pump happened to have its inlet 2 ft (for example) above the floor, then the heating contractor who preferred to use the substitute pump would have to bear the cost of lowering the floor of the pump room, with higher walls, added sewer depth, etc.

A vacuum return system of steam circulation is an exceedingly flexible and adaptable device. It works by maintaining a pressure differential between the inlet and outlet sides of various sensitive traps, one such trap generally being placed on the outlet of each heat transmitter and between ends of steam mains and the ends of condensate return mains. For every pound of pressure difference between the two sides of the trap, water will stand 27.71 in. higher in the side having the lower pressure than in the side having the higher pressure. There are influences beyond the exact pressure difference, of course, such as frictional resistance to flow of water or gas through a pipe, but no one worries at all about a vacuum return system that has the main perfectly level.

If a long return main, thus level, or a return main having less than the discussed ½ in. fall in 15 ft, arrives at the vacuum pump and is asked to rise 2 or 3 ft before entering the pump inlet, no worry need be felt about the successful operation of that plant. If the steam pressure isn't sufficient to force the condensate up, the very potent subatmospheric pressure induced by any self-respecting vacuum pump will permit atmospheric pressure to force the water up and there will be intermittent harmless little swallows of it between gulps of air.

No experienced steam designer goes around hunting for lifts in vacuum return mains, but lifts can be endured and they operate, within reason, for year after year. Well-proved piping arrangements to facilitate operation of these condensate lifts are printed in the catalogs of the vacuum trap manufacturers.

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Read the "Open for Discussion" pages in HPAC each month. They include comment on published articles, and other matters of interest.

Heating, Piping & Air Conditioning

THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS

JOURNAL *SECTION*

Balancing a Steam Heating System by the Use of Orifices

By Delman E. Schroeder*, Ames, Ia.

SUMMARY — Drilled orifice plates inserted in radiator valves of two-pipe steam systems together with proper application of temperature controls have effected substantial savings in steam requirements of buildings on the campus of Iowa State College.

Using the Service Building as an example, steps to be taken in the installation of orifices are outlined and results of operation are shown in tables and charts.

A capacity chart plotted from test results and used in selecting orifice sizes, is included.

THE VARIOUS steps to be taken in obtaining proper steam distribution by means of orifice plates installed in the valves of a steam heating system are illustrated in the description of the installation which was made in the Service Building of Iowa State College, Ames, Ia.

After two years of unsatisfactory operation, a successful change was effected in this building through the installation of a drilled orifice plate installed in each radiator valve between the valve body and tail piece.

Because the troubles encountered in this building are not unique in the heating industry, and because records were kept of the steam consumption for the building, the information and experience gained from this job should prove valuable to heating engineers and building owners who may be considering the installation of orifices as a means of correcting steam distribution difficulties.

The Service Building is only one of many buildings on the campus having orifice plates as a means of controlling steam distribution.

The Service Building (Fig. 1) is a T-shaped, three-story building, without basement, of brick and tile construction. The rectangular main part of the building, having a full north exposure, is 149 ft 9 in. long × 44 ft 9 in. wide and has extending from the center on the south side a 62 ft 9 in. × 29 ft annex. The visual instruction service, printing department, radio station and various other service agencies are housed in the building which was completed in 1939. With the exception of the broadcasting studios and a film storage vault, the entire building is heated by direct radiation. The broadcasting studios, located on the top floor, have controlled winter and summer temperature and humidity regulated by the condition of the air used for ventilation. The film storage vault, located on the ground floor, is completely surrounded by warm areas and requires cooling the year around.

Similarity of occupancy and usage plus the uniform building construction and the consistent use of the same type of radiation throughout the building made this heating installation highly adaptable to zoning and zone control. The shape of the building and its physical arrangement dictated that the building be divided into three heating zones including the rooms having north, southeast, and southwest exposures, respectively.

Wall-hung tubular radiators supplied the heat for the rooms and halls. Steam at 3 psig was supplied to the direct radiation through upfeed risers from zone mains located in an underground pipe trench

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Fig. 1—View of North side of Service Building, Iowa State College, Ames, Ia.

around the periphery of the building. The steam for the building was supplied by the college heating plant and taken from the distribution mains in the tunnel at a point near the northwest corner of the building. All of the condensate was collected in a single pipe and was metered before being returned to the heating plant.

The essential control elements in each zone consisted of a control responsive to weather conditions and mounted on the outside of the building in a location representative of the exposure for the zone, plus an automatic valve, located ahead of the first radiator in the zone. The valve was maintained in either a fully open or fully closed position by the outside control. The three zones were controlled in an identical manner. Night and holiday shut downs were accomplished by a program clock in the control circuit set to switch the control, at a predetermined time, to a low-limit thermostat installed in the building. In the morning the control function was automatically returned to the outside control. An adjustable type orifice plate was inserted between each radiator valve and valve tail piece.

The winter of 1939-40 was the first season of operation for the system. A considerable amount of general service work was required to remove defects in the mechanical parts of the system. Numerous complaints concerning uncomfortable room temperatures were reported. The nature of the complaints was not uniform enough to indicate fully the exact trouble. Quite a number of people were too warm, but an occasional complaint indicated a cold or cool room. By the end of the season, however, the purely mechanical troubles were eliminated and a pattern of short *heat-on* periods with long *heat-off* periods had been established.

The short *heat-on* periods were necessary because all of the radiators in any zone would at once be filled with steam whenever a zone valve opened, and if allowed to remain open for any duration of time would cause severe overheating. The long *heat-off* periods were necessary to allow time for the abnormally large inflow of heat to be dissipated. These unbalanced on and off periods caused some rooms to be cold while others were too warm since the rate of cooling varied somewhat from room to room. Therefore, in order to keep the building at a workable temperature for all occupants, the controls were set to keep the cold rooms sufficiently warm for minimum comfort requirements. This practice led to general overheating and poor economy, particularly in mild weather.

One other problem presented itself to further complicate the already bad situation; there were some occupants who were not comfortable at temperatures that were quite satisfactory to other people in the same room. While no heating engineer, unless he has prior knowledge of the exact conditions to be met, can design a system that will keep every occupant comfortable, it is the obligation of the operating engineer to make every effort in behalf of those people who are not comfortable in the normal zone of comfort. It is useless to tell a shivering or perspiring occupant that he should be comfortable because research indicates that 95 percent of all people tested are comfortable under similar conditions.

At the end of the first heating season it was apparent that the control system and steam distribution system were not in balance. Attempts were therefore made, first to adjust the orifice plate in each radiator to obtain approximately the same rate of heating throughout the zones and, second to adjust the controls so that the *heat-on* periods would be of sufficient length of time, or of sufficiently rapid recurrence, to eliminate a prolonged *heat-off* period.

Before the heating season of 1940-41 began, the control system was carefully checked and made mechanically correct. All of the steam traps were thoroughly cleaned and adjusted and all parts of the steam distribution system examined to make certain no air or water could accumulate in pockets, and that nothing would prevent the steam from readily distributing itself throughout the system. With the advent of the heating season, an attempt was made to adjust the orifice plates to obtain uniformity of heating within the zones. Little or no improvement was obtained from the attempt to adjust the orifice plates. While it was possible to affect materially the distribution of steam within the system itself, it was not possible to control the delivery of steam into each radiator to the extent of obtaining desired room temperatures.

This was due to our inability to determine how much steam would flow through an orifice at a given setting and to the difficulty of obtaining fine enough adjustments of the orifice. It was also found that some orifice plates gradually changed adjustments over a period of time. It was especially difficult to prevent the radiators nearest the zone valves from becoming hot before steam reached the last radiator off the main. However, all but the most persistent complaints about cold rooms were eliminated.

By the end of the second heating season it was apparent that in order to obtain both satisfaction and economy from the heating system, it would be necessary to have orifice plates of a fixed and very exact size in each radiator. The area of the orifice opening would have to be such that at outside design conditions just enough steam would flow through the orifice to replenish exactly the heat lost from the room. To accomplish this desired result it was necessary to know just how much steam would pass through a given orifice area at a given pressure differential, and just how much steam would be required to supply the heat needed for each room at outside design conditions.

The first of these requirements caused some concern. On the campus there were several heating systems in which drilled orifice plates were incorporated in the radiator valves, but for a given heat loss and steam condition there were wide discrepancies in the area of orifice used. When comparing rooms having a similar heat loss but located in different buildings, it was not unusual to find the area of opening in one orifice to be four times that of another orifice. Further, a review of published material available from books in the college library and from manufacturers' publications indicated that there were no industry-wide standards for orifice capacities. Since the quality of steam varied from very wet in mild weather to very dry in cold weather, it seemed advisable to determine the steam flow through various sizes of orifice openings at varying pressure differentials under the actual conditions of operation to be encountered.

Arrangement for Test

The test arrangement used to determine the steam flow through different area openings under various pressure differentials is shown in Fig. 2. Steam was taken from the steam main in the tunnel, passed through an orifice in the angle valve, then condensed and collected. Steam supply pressure and temperature were measured. Entrained condensate was removed through a steam trap before the steam reached the hand-operated gate valve. The orifice was inserted in a standard radiator angle valve. The condenser consisted of a coil of copper tubing in a water tank. Steam flowing downward through the coil was condensed by cooling water entering at the bottom of the tank and running to waste from an outlet at the tank top. The condensate was collected in a glass beaker.

The pressure differential, measured by the rise of a column of mercury in a U-tube, was controlled by operating the hand valve to obtain the pressure differential required. The condensate temperature was maintained relatively constant at a temperature low enough to prevent re-evaporation.

No special attention was given to the selection of drill sizes nor was any conversion of units made. The area of orifice opening was determined by simply using the drill bits that were handy at the time the orifice plates were drilled. The plates themselves were thin metal disks about 0.018 in. thick, upset on the rim to fit into the radiator valve tail piece.

Two one-half hour runs were made for each change of condition. After each test run the condensate collected in the receiver was weighed and if the results of two successive tests were not equal, additional one-half hour test runs were made until confidence could be placed in the results. The results in graphical form are reproduced in Fig. 3.

The author is fully aware of the limitations of this method of testing and the results obtained therefrom, but it must be remembered that the object was to approximate the actual conditions that would exist in the heating system, and not to make a thermodynamic analysis of the steam flow through an orifice.

In conducting the tests from which the curves in Fig. 3 were drawn, the initial steam pressure never exceeded 5 psig, this being the pressure of the supply steam. While nothing definite is known of the actual pressure on the discharge side of the orifice plate it is obvious, from an examination of Fig. 2, that the discharge pressure could not have been much greater than atmospheric.

In any case the flow conditions of the test closely approximated those encountered in the actual heating

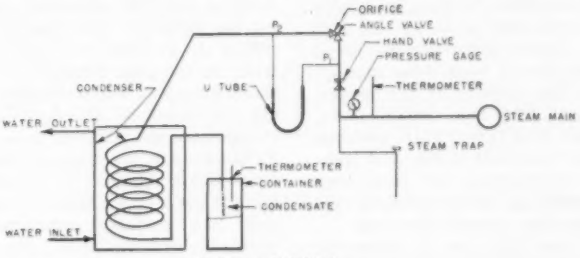

Fig. 2—Test arrangement for determining steam flow through orifices
(Maximum initial pressure 5 psi gage)

Table 1—Typical Daily Steam Record of Service Building During Winter of 1940-41

Date	Pounds of Steam used	Degree Days	Pounds Steam per hour	Return Temp.
Jan. 7	9,814	38	258	140
8	9,445	36	262	180
9	10,279	45	228	140
10	8,420	34	248	170
11-12	13,096	59	222	160
13	8,400	35	240	160
14	8,804	35	249	160
15	8,392	34	246	135
16	8,734	34	256	170
17-18-19	32,914	168	196	160
20	9,840	45	219	145
21-22	16,382	83	197	155
23	9,534	44	218	150
24	8,086	37	218	165
25-26	16,480	82	201	185
27	8,478	47	180	170
28	8,642	47	184	180
29	8,756	40	219	140
30	7,869	39	201	160
31	7,855	37	212	145
Feb. 1-2	14,905	72	207	150
3	8,149	35	232	165
4	9,070	35	259	155
5	8,846	34	260	160
6	11,508	48	241	160
7	11,640	52	224	180

Table 2—Typical Daily Steam Record of Service Building During Winter of 1941-42

Date	Pounds of Steam used	Degree Days	Pounds Steam per hour	Return Temp.
Oct. 27		29		105
28	5,998	23	374	110
29	5,700	25	356	180
30	7,690	26	495	110
Nov. 3	4,766	18	297	110
4	4,485	25	298	105
5	7,207	32	424	110
6	7,632	34	477	110
7	8,990	36	544	149
10	6,707	31	432	110
11	7,102	30	439	110
12	4,250	17	265	105
13	4,526	17	274	110
14	4,295	18	267	135
17	1,440	1	90	105
18	1,452	2	91	95
20	8,466	34	529	115
21	5,834	29	359	115
22	8,692	41	541	110
23	9,328	44	582	120
24	6,996	33	435	115
25	5,514	26	345	120
26	4,452	21	278	115
27	4,028	19	251	115
28	2,756	13	172	120
29	3,392	16	212	110

system after the orifices were installed. While no tests were made with initial pressures higher than 5 psig or lower than atmospheric final pressure, experience with other campus installations does indicate that satisfactory results can be obtained with orifice plates sized from the curves in Fig. 3 for initial pressures up to 5 psig and return pressures as low as 6 in. Hg vacuum.

Steam Requirements

The next step was to determine accurately the net heat loss of each space to be heated. A great deal of care was used in this step to account for every factor affecting the heat requirements. Wherever it could accurately be done, heat gains were accounted for as well as heat losses. Due consideration was given to the type of work done in each space, the activity of the people, the heat gain from steam risers, and the final temperature required in the individual rooms and hallways. Calculations of riser sizes indicated that the distribution system was not greatly oversized.

The next step was to determine the exact load each radiator was to carry. It was possible, if there were two or more radiators in a room, to admit more than the normal amount of steam to the radiator nearest a person requiring extra heat. In the case of one long room having south, west, and north exposures, the northwest corner radiators were given a much greater share of the load than were the west and south radiators. One radiator adjacent to a stapling machine carried very little load due to the activity of the operator.

When each radiator had been assigned its proportionate share of the Btu heat load, the required pounds of steam per hour were determined. In converting the Btu heat load to pounds of steam required, the Btu given up per pound of steam was determined from the difference in enthalpy of the steam entering and the condensate leaving the radiator. The steam pressure at the radiator valve inlet was taken as the gage pressure on the steam main and was assumed to be dry and saturated. The condensate temperature was assumed to be 150 F, based upon the average return temperature obtained from radiators equipped with orifices in rooms that had operated satisfactorily during the previous heating seasons.

Orifice sizes were obtained from the Chart, Fig. 3, and were based upon the pounds of steam required per hour and an assumed pressure differential of 3 psi. In actual operation this differential was reduced to 2 psi in mild weather, and raised to 4 psi in severe weather. This fluctuation of steam pressure served to maintain a building temperature cooler in mild weather than during extremely cold periods. From the viewpoint of both comfort and economy this inside temperature gradient, though only from two to four degrees, was found to be most desirable. The pressure on the return system was considered to be atmospheric.

Operating Results

As was the case in previous years, accurate daily heating data records were maintained. Tables 1 and 2 are samples of the type of data collected for the winters of 1940-41 and 1941-42, respectively. These two data sheets indicate the effort used in determining the performance of the heating system and illustrate some pertinent facts concerning the operation of the heating system.

The condensate meter was read at the same time during each day listed on the data sheets. The degree days were calculated every 24 hours by averaging the hourly temperatures of the preceding day. During the 1940-41 heating season, the building was heated the same number of hours each day regard-

less of Sundays and holidays, but during the season of 1941-42 the heating system was operated at reduced temperatures on all Sundays and holidays. Changes were also made in the time of night shut down at the different seasons.

Perhaps the most significant daily information obtained from these data sheets is the comparison of return temperatures. The average return temperatures for the 1940-41 season were close to 160 F, while those of the season of 1941-42 averaged approximately 115 F. Since the condensate in which these temperatures were obtained included the condensate from the drip traps on the mains and risers and from the hot water heater, it is apparent that the temperature of the condensate leaving the radiators is lower. Low temperature of condensate is important because it reduces trap maintenance, reduces uncontrolled heat gains from exposed return pipes, and reduces piping strains caused by expansion and contraction. In cases where condensate pumps are used, low temperature condensate reduces possible trouble due to flashing into steam in the pump. The mechanical operating condition of the heating system itself is also reflected in the condensate temperature. A trap passing steam at even the most remote point in the system will serve to increase the condensate temperature. By careful observation of these daily condensate temperatures it is possible to detect occasional mechanical irregularities in time to prevent expensive repairs.

At the end of each heating season a summary of the heating requirements of the building was made. Table 3 for the heating season of 1940-41 is typical of these annual summaries. The data summarized on these annual sheets were used to plot the performance curves in Fig. 4. When used in conjunction with summaries of other years, data in this form yield a great deal of comparative information in a highly usable form.

Fig. 4 presents graphically the results and effect of all of the work done on the heating system in the Service Building. While each year's performance curve may be compared to the calculated steam requirement, the shaded area represents the net savings over all other conditions of operation. No attempt is made here to analyze all of the information available from this set of curves. The author has never determined to his own satisfaction the reason for the flattening of the curves between approximately 35 and 55 degree days. It is interesting to note that this same curve shape exists in the results obtained from

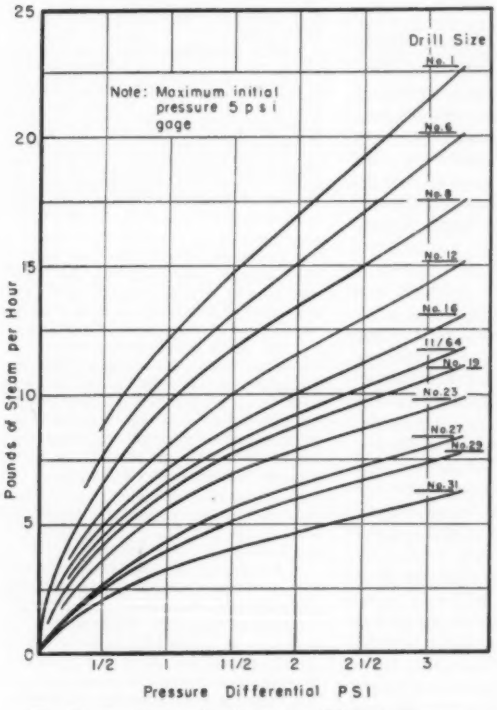

Fig. 3—Capacities of orifices for different pressure differentials

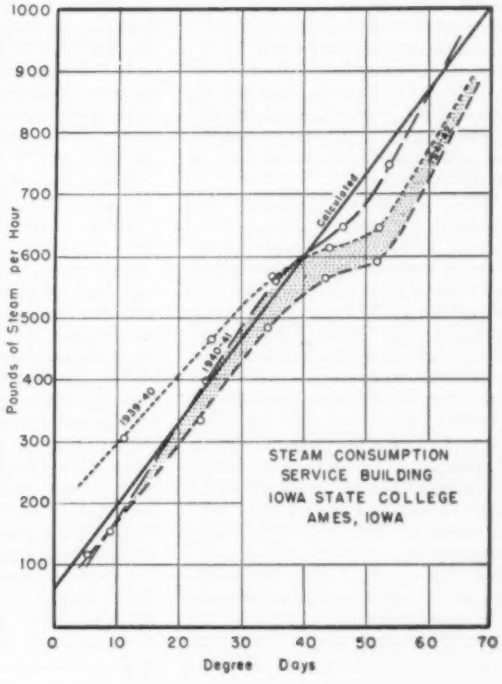

Fig. 4—Comparison of steam requirements of the Service Building for a three year period

Table 3—Weather Data and Steam Requirements of Service Building for Heating Season of 1940-41

Degree Day Range	Average Degree Day	Average Steam used Pounds	Pounds of Steam per Hour	Pounds of Steam per D.D.	per hr/D.D.
1-15	8.8	2,391	154	272	17.5
16-30	24.4	6,190	398	258	16.3
31-40	35.6	8,695	560	244	16.0
41-50	46.2	10,015	646	217	14.0
51-60	53.6	11,600	746	216	13.9
61-up	62.5	12,566	810	204	12.9

Month	Degree Days	Steam Used Pounds	Steam per D.D. Pounds	Days having D.D.	Average month D.D.
Sept.	212	53,095	251	21	10.1
Oct.	394	90,625	230	29	13.6
Nov.	1,123	264,050	235	30	37.4
Dec.	1,185	283,742	239	31	38.2
Jan.	1,267	273,654	216	31	40.8
Feb.	1,140	261,423	229	28	40.7
March	842	197,759	234	31	27.2
April	214	57,965	271	17	12.6
May	64	18,950	296	9	7.1

Total number of Degree Days	6,441
Total pounds of steam used	1,501,263
Average outside temperature	39.7 F
Total days requiring heat, Sept. 9 to May 24	227

every building on the campus, for which data are available, regardless of the type of heating system.

Because the steam used for domestic hot water heating is metered along with steam used for space heating, the curves in Fig. 4 cannot be considered accurate below 25 degree days. And since there are not a sufficient number of severely cold days in the winter to make the results conclusive, the curves cannot be considered accurate above 65 degree days.

Since it is important to note the relative position of the various curves with respect to calculated requirements, something should be said about the curve bearing the designation *calculated*. This curve is based upon the sum of the heat losses calculated for each room and is not the same as one calculated from the overall dimensions of the building. When the heat loss of an individual room is calculated, design conditions of outside and inside temperatures and wind velocities are assumed, and the physical construction of the building is taken into account. However, when a design day occurs, it does not occur on all exposures of the building at the same time.

For example, it may be said that a building must be heated to an inside temperature of 70 F when the outside temperature is —15 F and wind velocity is 15 mph. Such a day may occur with a northwest wind, making the shaded north side of the building very close to design conditions, while at the same time the south side may be affected by the rays of the sun and be subject to almost no wind velocity. Yet the heat required to keep the building at 70 F throughout, will be affected by every outside condition existing between these two extremes. Therefore, if the inside temperature is controlled at 70 F throughout the building, the fuel consumed will be less than that calculated for the building under the design conditions.

In the case of the Service Building, the condensate metered was collected from all of the zones prior to metering and reflected the fuel requirements of the entire building at the same instant, and therefore was less than that amount necessary according to calculations. The relative distance on the graph between the curves for actual fuel consumption and the calculated requirement will serve as an indication of the value of additional expenditures to increase fuel economy.

Additional benefits resulting from the installation of orifices in the heating system are indicated by the fact that since the installation and final adjustment of controls have been completed there have been no troubles reported from the Service Building due to the orifices, and repairing of steam traps has been largely confined to those traps that drip the steam mains. There has been from time to time a rearrangement of rooms and usage that has required changes in room temperatures. These changes have been readily obtained by correcting the orifice plates in the radiators affected to meet the new condition.

Recommendations for Orifice Installations

The following steps should be followed when installing orifices in radiators of any two-pipe steam system:

1. Make sure that the heating system is mechanically in proper working condition, i.e., that the steam and condensate lines are properly sized, pitched, and clear of obstructions. Be certain that the radiators are large enough to dissipate the amount of heat required. Make certain that the traps, especially those on the steam mains, are in good working condition, and that the system is properly vented. If the distribution system is not in good mechanical working condition, orifice plates will be of little value.

2. It is necessary that the control system be in proper mechanical condition. There must be enough control instruments, correctly located and installed, to obtain the results desired. Temperature control instruments react to ambient atmospheric conditions, not to the desires of the occupants or engineers. The importance of an adequate control system cannot be overemphasized.

3. Calculate carefully the heat loss of each heated room because the final results will depend largely upon the care used in this step. Keep a permanent record of the calculated heat losses. For the inside design temperature, use the actual temperature desired, not just an arbitrarily selected 70 F. Include heat gains as well as heat losses. The author recommends the procedure set forth in THE GUIDE published by THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS for this step.

4. Assign to each radiator its proper share of the Btu load, giving consideration to the individual temperature requirements of the occupants.

5. Determine the size of orifice required to furnish the Btu output for each radiator. The curves in Fig. 3 may be used in this step. Since it will be necessary to assume a pressure differential, no harmful error will result if the gage pressure on the steam main is considered as the pressure differential if there is no positive pressure in the return system. If there is a vacuum in

the return lines, the actual pressure differential across the orifice should be used. It will be necessary to use the difference in enthalpy of the entering steam and the leaving condensate to determine the pounds of steam per hour required for each radiator. However, in assuming the condensate temperature the estimated temperature of the condensate after the orifices are installed should be used. While no set temperature can be assumed, experience with buildings on the campus of Iowa State College indicates that return temperatures will seldom be more than 150 F, or less than 100 F.

6. Drill the orifice plates (several types of good plates are available) and install them in the radiator valves. The type of radiator valve used will, to some extent, determine the type of orifice plate installed. Care should be used in drilling to obtain round holes without burrs or irregularities.

7. When the heating season starts, make any adjustments necessary in the temperature controls. The types and methods of control are so many and varied that no detailed procedure can be given here, but in general the ideal condition is to have the *heat-on* periods as long or as frequent as possible, and the *heat-off* cycle as short as possible. Advice of the control manufacturer may be necessary if the conditions are unusually difficult.

8. From time to time it may be necessary to change some orifice sizes in order to make individual adjustments in room temperatures. Uneven pressure conditions in the steam mains from first to last radiator can be taken care of after the system has been put into operation.

There are some serious limitations in the use of orifice plates in radiator valves. The following three exceptions and objections are perhaps the most common.

1. If the steam used contains mineral salts, there is a tendency for deposits to form around the opening in the orifice plate. These deposits reduce the area of opening and will utimately cause failure of the heating system. If the steam is extremely bad, the work of keeping the orifice plates clean will more than offset any advantages that may be obtained from their use.

2. Orifice plates based upon the curves in Fig. 3 should not be used in one-pipe heating systems and hot water heating systems. The orifice opening is much too small to allow liquid to flow against the flow of steam.

3. Frequently when the radiators are disconnected for painters or other workmen, the orifice plates become lost and no replacements are made when the radiators are reconnected. If even a few orifice plates are left out, a breakdown of the entire system will result.

While the correction of distribution problems is of immense assistance to temperature control, orifice plates must not be used as a substitute for a sufficient number of properly applied temperature control devices. There seems to have developed the opinion, held by many heating engineers and building owners, that the troubles encountered in a heating system are directly proportional to the number of controls installed. However, it has been the writer's experience that a lack of properly applied controls can only result in loss of both economy and comfort.

Economical heating and comfortable temperatures can result only if the flow of heat to the space to be heated is in a sufficient quantity, properly distributed, and completely controlled. The function of the orifice is to aid in the proper distribution and metering of the steam and it can fulfill no other function.

The use of orifice plates in a heating system is not a cure-all that will overcome all troubles and correct all errors of design. In fact, orifices improperly and indiscriminately used may cause more trouble than that encountered without them. The use of orifices however is based upon sound fundamental principles and when these principles are correctly applied the orifice will become a useful component of the entire system.

Acknowledgment

Acknowledgment is made to Gladys Bader and Don Bice for their able assistance in the preparation of this manuscript and to Professor John Sandfort for his generous advice and counsel.

ECPD MAKES SEVENTEENTH ANNUAL REPORT

The Seventeenth Annual Report of the Engineers' Council for Professional Development, 29 West 39th St., New York, N. Y., devotes 47 pages to a description of its contributions toward the betterment of the profession.

The *ECPD* was organized in 1932 to enhance the professional status of the engineer through cooperative efforts and concerns itself with the professional, technical, educational, and legislative phases of the life of the individual engineer. Its principal work is done by four standing committees who address themselves to the betterment in methods of selection and guidance of the student engineer, the content of his college curriculum, the orientation of the graduate engineer in industry, and finally the procedures by which he is awarded professional recognition. The actual work of the *ECPD* is done by some 300 educators and practicing engineers who volunteer their services in the interest of the profession.

In the lead article, J. W. Parker, retiring *ECPD* chairman, calls attention to the following progress achieved during the past year:

1. The Pre-Engineering Inventory, a battery of tests for aptitude and achievement developed under *ECPD* sponsorship, was placed on a self-supporting basis and made more accessible to guidance counselors and persons desiring to be tested.

2. Accrediting of engineering curricula was continued and a program to establish minimum standards of content of engineering curricula was initiated.

3. In the field of professional training steps were taken to establish a seven-point program directed toward extension of educational processes into the period following graduation. The plan envisages a program for continuing engineering education into and through the years of active employment.

4. With regard to professional recognition the Council adopted uniform nomenclature for designating the several grades of membership in constituent societies and established minimum standards for admission.

5. The Council's Canons of Ethics for Engineers was widely adopted by engineering organizations having an unduplicated membership of 100,000 engineers.

6. *ECPD's* publications, *A Professional Guide for Junior Engineers* and *The Second Mile* by Dr. Wickenden, were called to the attention of practicing engineers through news releases and announcements in the journals of constituent societies.

A LETTER TO THE PRESIDENT

DEAR FELLOW MEMBERS IN ASHVE:

I thought you would enjoy these observations of our flying ambassador, Carl F. Boester, on his recent trip as much as I did.

Sincerely,

LESTER T. AVERY, *President*

Dear Lester:

I wish to report concerning my recent visit in England, Scotland, Ireland, Belgium, France, Holland, Germany and Switzerland. The purpose of my mission was to study current European practices and recent ideas on high temperature forced-hot-water heating systems. Acting on your suggestion, I contacted some of the British and French members of the Society in London, and I met the officers of *The Institution of Heating and Ventilating Engineers* of Great Britain and attended one of their meetings at which recent researches on the subject of British domestic heating equipment and appliances were discussed by Richard Rawse, whom I had previously met on his visit to America. The subject was one of keen interest to me and therefore I was extended the privilege of participating in the discussion of the paper. I also extended to the group the best wishes of the president and officers of the ASHVE and briefly told of some of our current endeavors, explained our Research Program, and urged a greater interchange of information, suggesting among other things, that some of the members of the Institution should offer papers for some of our meetings.

At a meeting of the *Institute of Fuels*, A. Margolis presented a paper on the subject of district heating, which is being considered for British towns that are being rebuilt. This happened to be an interesting and spirited paper and there was considerable discussion. I was likewise invited to participate at this meeting, and therefore, extended the felicitations of yourself and the officers of the Society, and again urged closer team work between the two organizations.

At the Government Building Research Station, Garston, Watford, Herts, I found an extensive program in heating and ventilating research, carried on by a highly competent and imaginative staff of engineers. There is quite a bit of work going on at this research center which would, I am sure, be of interest to our membership. Doctors Lee, Pickles and Weston were most cooperative in telling of their work and their facilities.

Another interesting experience was an inspection of the new high temperature forced-hot-water heating system being installed in Buckingham Palace and in this connection I am sure that I had a more thorough tour of the Palace and saw many parts of the Palace not available to visiting Americans or natives. The King's apartment has a new heating system, but the poor operating engineer is having a very tough time because the King likes it warm and the Queen prefers it cool. There are over 400 open fireplaces in the Palace and in addition, parts of it had a steam system which is being completely replaced.

G. Nelson Haden, who was in Cleveland for our 53rd Annual Meeting, was most generous of his time and showed me a large government building in which he was installing the heating system.

In Paris at a dinner meeting on April 19, I was privileged to meet with a dozen French members of our Society including Pres. André Desplanches of the *Association des Ingenieurs de Chauffage Et de Ventilation de France*. On the occasion I discussed at some length the merits of a closer relationship between our two Societies, urging that more of their members become members of our group and apparently this suggestion is already bearing some fruit. Paul Blondel, who attended the Dallas Meeting last January, gave an informative and entertaining report on his experiences and his impression of the Annual Meeting and Texas, where he was "taken into custody" by our Reception Committee for not having a *Passport to Texas*.

The meeting started at 8:00 p.m. with a very elaborate dinner and the discussion lasted until 1:00 a.m. For the most part, the discussion was in English as practically all of those in attendance understood English, so no time was lost and the services of an interpreter were unnecessary. Those in attendance were: Auguste Beaurrienne, Paul Blondel, Carl F. Boester, Roland Bollaert, M. V. Bracka, André Desplanches, Fernand Ghilardi, Paul R. Marchal, André Missenard, André Nessi, Foster J. Pratt, and B. Tunzini.

While in Paris I saw the heating installation of 70 million Btu capacity in the new Bank of France Building, which has a complete boiler plant, oil and gas fired, and also is served by steam from a city plant. There were many interesting features of this installation but none of them were applicable to our problems.

In Switzerland I visited the plants of the Brown and Boveri Co. and the Sulzer Brothers Co. In Zurich, I saw a very interesting district heating system operated by the Technical Institute and Engineering School. It was partly low temperature water and partly high temperature water and it had three different types of oil fired boilers. Also hooked up to it were electric boilers to take advantage of excess electric power at certain seasons of the year, and to further complicate the system, it had two large heat pumps hooked to it, one an ammonia unit with a reciprocating compressor and the other a centrifugal compressor operating on freon 11. The entire system was very well engineered and extremely well run. It was more of an engineer's dream than a practical reality from the standpoint of the design and operation as compared to most district heating systems.

It is my general observation, after having completed the seven weeks trip, that everywhere I went, the heating, ventilating and air conditioning business is an extremely interesting and prosperous one to be in. Techniques have been greatly improved and standards considerably elevated. More heating installations are being made than ever before. Since the economies of the countries I visited are quite different from ours, I found that their heating application practices are also quite different, and while I saw numerous, ingenious applications there was nothing new or novel that the American heating engineer could use. It was possible to tell many people what was new in American thinking and how and where they might obtain more detailed information concerning the things that were of interest to them.

Generally speaking I found the economy of Europe much better than I had visualized and the pleasant reception I experienced leaves many enjoyable recollections of both new and old friendships.

Cordially,

CARL F. BOESTER

Effective Solar Absorption of Various Colored Paints

By R. H. Heilman* and R. W. Ortmiller**, Pittsburgh, Pa.

SUMMARY — Solar absorption coefficients were obtained by tests in which nine different paints were exposed to direct solar radiation in a special test apparatus which is described. Emissivities of various types of surfaces obtained by other investigations are also listed. A discussion of results is included.

At the suggestion of the ASHVE Technical Advisory Committee on Cooling Load, solar absorption tests were run to determine the absorption coefficients of numerous paints exposed to the direct radiation of the sun.

There is considerable information available in the literature on absorption coefficients or emissivities of numerous surfaces for radiation at various wavelengths; also there is some information giving relative heat absorptions and temperatures attained by surfaces exposed to the sun. There is very little information, however, giving actual coefficients for surfaces exposed to the sun. The tests reported in this paper were run primarily to obtain these coefficients and to make a comparison between the absorption coefficients of paints obtained by direct exposure to the sun and those obtained by exposure to radiation at wavelengths approximating the wavelength corresponding to the maximum intensity of the sun.

Investigators have found that some surfaces exhibit selective reflection characteristics, the reflection coefficients varying widely for comparatively small differences in wavelength of the incident radiation. For instance, Coblentz[2] obtained reflection coefficients for chromium oxide of 24.1, 27.0 and 44.6 at wavelengths of 0.54, 0.60 and 0.95 microns respectively.

Description of Apparatus and Paints

The apparatus used in making the tests consisted of a sensitive thermopile containing 96 very thin thermo-elements connected in series and previously described by Heilman[1], a portable precision potentiometer, and a rigid mounting device which held the samples and the thermopile in a definite position relative to each other. The assembly of the sample holder, the thermopile and a sun sight was mounted on a rotating member so that the face of the sample could be held perpendicular to the sun's radiation at all times during a measurement. A photograph of the test assembly less the potentiometer is shown in Fig. 1. An insulated shield was placed around the assembly to protect the sample and thermopile from air currents.

The paint samples (most of which were supplied by the ASHVE Research Laboratory) were applied to aluminum foil 0.00035 in. thick in order to keep the mass of the receiving surface at a minimum. The

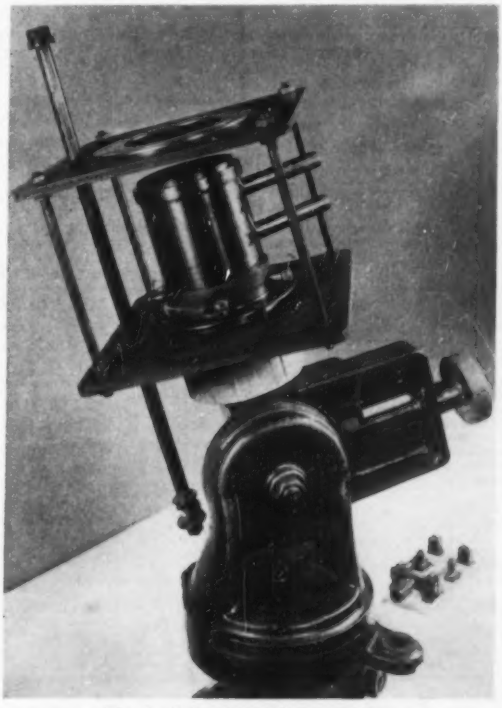

Fig. 1—Solar absorption apparatus

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[1] Exponent numerals refer to References.
For presentation at the Semi-Annual Meeting of The American Society of Heating and Ventilating Engineers, Muskoka, Ontario, Canada, June 1950.

underside (the side of the aluminum foil exposed to the thermopile) was painted with a flat black lacquer. The emissivity of the black lacquer as measured at atmospheric temperatures was 0.95. A standard receiving surface of aluminum foil having flat black lacquer on both sides was used alternately with the test samples to minimize possible variations in the sun's intensity due to invisible clouds or moisture and to change in altitude of the sun. The time required to make the observations on a given sample was usually less than 5 min. The samples of the regular or white asbestos paper and black asphalt-saturated paper were approximately 0.025 in. thick. Their *black heat* emissivities were the same, 0.93. The analyses of most of the paints tested are shown in Table 1.

Calculations of Test Results

The thermopile had previously been calibrated so that the emissivity of a surface could be determined from measurements of the electromotive force (emf) generated by the thermopile, the emf generated by a thermocouple attached to one of the cold junctions, the temperature of the surface whose emissivity was being measured, and the temperature of the receiving surface of the thermopile. The temperature of the receiving surface could be calculated from the temperature of the cold junction and the number of hot junctions connected in series. The constant of the thermopile was 0.118×10^{-10}.
Then

$$e = \frac{D}{0.118 \times 10^{-10} (T_1^4 - T_2^4)} \quad \ldots\ldots (1)$$

where

e = emissivity of surface.

D = net electromotive force generated.

T_1 = temperature of surface, Fahrenheit, absolute.

T_2 = temperature of receiving surface, Fahrenheit, absolute.

Also the heat loss by radiation, q_r, Btu per (hr) (sq ft) between the two surfaces is:

$$q_r = 17.4 \times 10^{-10} e (T_1^4 - T_2^4) \quad \ldots\ldots (2)$$

substituting for value of e (from Equation 1),

$$q_r = 17.4 \times 10^{-10} \frac{D}{0.118 \times 10^{-10}} \frac{(T_1^4 - T_2^4)}{(T_1^4 - T_2^4)}$$

$$= 17.4 \frac{D}{0.118}$$

$$= 147.5 D \quad \ldots\ldots (3)$$

In Equation 2 e is the effective emissivity between the two surfaces and is accounted for in the constant of the thermopile. Since the same black surface was exposed to the thermopile at all times, it was assumed that it would measure accurately at all times the radiation loss from the underside of any of the test specimens. The heat loss from the underside of the surface by conduction can be considered to be negligible. The heat loss by convection from the underside would also be very low because of the ¼ in deep depression in the hardboard plate holding the test sample and the length of travel the air would have to flow over the hardboard plate before it would reach the insulated sides of the assembly.

Temperatures of the underside of the test sample and the receiver of the thermopile were calculated for the white painted sample and the black painted sample. Assuming that the convection loss would be the same as that of a horizontal plate warmer than air facing downward (the actual convection loss would be very much less than this), it was found that the ratio of the total loss from the underside of the test samples to the ratio of the loss by radiation was 2.11 to 2.09, or less than 1 percent. It can, therefore, be assumed that the ratio of the radiation losses is very close to the ratio of the total losses from the underside. Since the object is to determine the effective solar absorption coefficient which is actually equivalent to the total heat transmitted to the underside of the sample, it is not necessary to be concerned with convection and reradiation losses from the top of the sample.

It was assumed that the solar absorption coefficient of the standard black surface was 0.95, the same as the measured *black heat* emissivity. The heat coming through the sample would, therefore, be increased by the ratio $\frac{1}{0.95}$ or 1.0525 if the top black surface had been a perfect black body.

The effective solar absorption coefficient, a, then, of a given surface, x, is

Table 1—Analysis of Paints Tested

	(1) Slate	(2) Yellow	(3) Green	(4) Brown	(5) White Enamel	(6) White	(7) White
Pigment by weight	64	63	38	44	38	61.5	59.5
Vehicle by weight	36	37	62	56	62	38.5	40.5
Pigment by weight:							
Leaded Zinc Oxide	49	44	-	12	-	-	-
Basic Sulphate White Lead	19	16	-	4	-	-	-
Zinc Oxide	30	28	6	8	-	29	-
Titanium Magnesium	40	43	-	-	-	62.1	-
Titanium Calcium	-	-	-	-	-	-	57.3
Magnesium Silicate	5	5	54	48	-	-	-
Basic Carbonate White Lead	6	8	-	-	-	-	-
Chrome Green CP	-	-	40	-	-	-	-
Ferric Oxide	-	-	-	40	-	-	-
Titanium Pigment	-	-	-	-	100	-	-
Calcium Carbonate	-	-	-	-	-	8.9	-
Lithopone	-	-	-	-	-	-	39.5
Silicates	-	-	-	-	-	-	3.2
Vehicle by weight:							
Linseed Oil	70	69	33	30	-	69.4	-
Drier	15	15	-	-	-	1.3	27.
Mineral Spirits	15	16	-	-	-	-	65.9
Varnish*	-	-	67	70	-	-	-
Spar Varnish	-	-	-	-	100	-	-
Petroleum Thinner	-	-	-	-	-	29.3	-
Resin	-	-	-	-	-	-	7.1

*Resin 8, Vegetable oils 40, Mineral spirits 52.
Other paints tested: Red roof paint (8) Aluminum paint (9) and Aluminum paint with asphalt vehicle (10).

Table 2—Effective Solar Absorption Coefficients of Various Paints and Materials

Material	Coefficient	Material	Coefficient
(1) Slate	0.69	(7) White	0.36
(2) Yellow	0.59	(8) Red Roof	0.66
(3) Green	0.93	(9) Aluminum Bronze	0.39
(4) Brown	0.83	(10) Aluminum Bronze	0.37
(5) White Enamel	0.42	(11) Aluminum Foil Bright	0.41
(6) White	0.51	(12) Regular Asbestos Paper	0.50
(6a) Same after 2 mos. exposure	0.68	(13) Black Asphalt Saturated Paper	0.93

$$\alpha = \frac{q_r \text{ (surface } x)}{1.0525\, q_r \text{ (black surface)}}$$

For example, the effective solar absorption coefficient of a white paint as observed is

$$\alpha = \frac{147.5 \times 0.279}{1.0525 \times 147.5 \times 0.63} = 0.42$$

If the assumed solar absorption coefficient for the black surface is high or low, the calculated absorption coefficient for the various surfaces tested will be correspondingly high or low. There was apparently little or no reradiation from the sky, as in most cases a negative reading was obtained when the sample was pointed to the sky away from the sun.

Results of Tests and Comparison with Other Data

The average of several observations for each material tested is given in Table 2.

The emissivities of some surfaces obtained by other investigators for radiation at a wavelength of 0.6 μ are shown in Table 3.

Discussions and Conclusions

Both paint samples 5 and 6 had a distinctive yellowish cast. Sample 7 was very white. Sample 6 was tested before and after two months exposure to the weather on the *Mellon Institute* roof. The tests indicate that the solar absorption coefficient can change very rapidly in Pittsburgh's atmosphere. The coefficient obtained on the bright aluminum foils confirms the general belief that aluminum foil on a roof is usually no more effective in reducing the heat load on the roof than a good white paint. This is due to the fact that the aluminum foil is a poor emitter of radiant energy in the infrared region while white paint is a good emitter in this region. The aluminum foil can reradiate to the sky and surroundings only a small portion of the energy it receives from the sun, consequently its surface temperature rises. The white paint can reradiate most of the energy it receives to the surroundings with a tendency for the surface temperature to drop. The net result is very little difference in the surface temperatures of the two materials. Actually the true solar absorption coefficient of aluminum foil is probably very much lower than that of white paint, while practically as far as heat gain is concerned there is very little difference as long as their surfaces remain in their original condition.

A direct comparison cannot be made between the white paints tested in this investigation and the white paints as tested by Coblentz[3] because the composition of the pigments and the vehicles are vastly different. It is reasonable to assume that the paints tested by Coblentz should have lower absorption coefficients as they contained nothing but the pure pigment and linseed oil.

The greatest sources of error in these tests are probably the changing intensity of the solar radiation and the assumption that the solar absorption coefficient is 0.95 for the black standard. The value assumed for this is probably accurate to within ± 3 percent. The rapidity with which the readings were taken should minimize the errors due to changing intensity. However, it is believed that more accurate results could be obtained if the tests were conducted in a region where the intensity is more constant.

The actual temperature of the sun has been variously estimated at from 10,000-11,500 F. The wave-

Table 3—Absorptivities of Various Substances for Radiation of a Wavelength of 0.60 microns

Material	Absorptivity	Authority
Bricks		
Light Buff	0.52	Coblentz[3]
Darker Buff	0.60	Coblentz[3]
Red	0.70	Coblentz[3]
Darker & Glazed	0.77	Coblentz[3]
Wire Cut red	0.61	Beckett[4]
Sand lime red	0.72	Beckett[4]
Mottled purple	0.79	Beckett[4]
Clay Tiles		
Machine Made red	0.68-0.71	Beckett[4]
Machine Made dark purple	0.82	Beckett[4]
Concrete Tiles		
Uncolored	0.65	Beckett[4]
Brown	0.85-0.87	Beckett[4]
Black	0.91	Beckett[4]
Metals		
Pure polished iron	0.45	Coblentz[3]
Magnesium	0.30	Coblentz[3]
Zinc, pure polished	0.46	Coblentz[3]
Duralumin	0.53	Coblentz[3]
Monel metal	0.43	Coblentz[3]
Molybdenum	0.55	Hulbert[5]
Nickel, electrolytic	0.40	Hagen & Rubens[6]
Speculum metal	0.39	Hagen & Rubens[6]
Slates		
Blue grey	0.87	Beckett[4]
Dark grey	0.90	Beckett[4]
Miscellaneous		
Galv. iron: white-washed	0.21	Beckett[4]
Asbestos cement: white	0.60	Beckett[4]
Asbestos cement: red	0.66	Beckett[4]
Roofing lead: old	0.81	Beckett[4]
Galvanized iron: new	0.66	Beckett[4]
Galvanized iron: very dirty	0.89	Beckett[4]
Enameled steel: white	0.47	Beckett[4]
Enameled steel: blue	0.83	Beckett[4]
Enameled steel: red	0.83	Beckett[4]
Enameled steel: green	0.88	Beckett[4]
Weathered asphalt	0.89	Beckett[4]
Bituminous felt	0.89	Beckett[4]
Asphalt pavement (dust free)	0.93	Coblentz[3]
Glazed porcelain	0.28	Coblentz[3]
White marble	0.47	Coblentz[3]
Pigments		
Blue (CO_3O_3)	0.97	Coblentz
Red (Fe_2O_3)	0.74	Coblentz[3]
Green (Cu_2O_3)	0.73	Coblentz[3]
Yellow (PbO)	0.48	Coblentz[3]
White (Al_2O_3)	0.16	Coblentz[3]
White (Y_2O_3)	0.26	Coblentz[3]
White (ZnO)	0.18	Coblentz[3]
White (ZrO_2)	0.14	Coblentz[3]
White Paints Ground in Oil		
White lead	0.25	Coblentz[3]
Zinc lead	0.30	Coblentz[3]
Zinc oxide	0.32	Coblentz[3]

length at which the intensity is a maximum for these temperatures is approximately 0.5 and 0.43 μ respectively, with most of the energy lying in the wavelength range of 0.1 to 5.0 μ. Since it is known that some substances exhibit selective radiation characteristics and since at least half of the energy emitted from the sun lies in the visible range, it would be desirable to check several identical samples by both methods using, if possible, wavelengths of 0.1 to 5.0 μ in the selective radiation tests.

Acknowledgment

The authors are indebted to Prof. R. C. Jordan of the University of Minnesota for the Bibliography on solar absorption determinations.

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A Study of Temperatures under Sheet Steel Roofs, by H. Giese, W. D. Scoates, and N. C. Ives (experimental determination of temperatures under sheet steel roofs exposed to sun) (*Agricultural Engineering*, Vol. 20, No. 7, July 1939, pp. 267-269).

ASRE SPRING MEETING IN KANSAS CITY

Kansas City's Hotel Muehlebach was headquarters from June 4 to 7, 1950, for the 37th spring meeting of the *American Society of Refrigerating Engineers*. The meeting was devoted to the presentation of technical papers on refrigerating subjects and, in addition, two engineering conferences on specialized problems of the industry were held.

At the technical sessions papers were discussed on such subjects as the testing and balancing of air conditioning systems, low temperature air conditioning, applications of a new refrigerant, refrigerated truck transportation, the prepackaging of meats for retail sale, and others were presented.

One of the conferences was a domestic refrigerator conference, which has proved so popular at recent meetings of the *ASRE*, and which featured application of insulation to household refrigerators and home freezers. The other conference was on the timely subject of water re-use. The conferences differed from the usual technical meeting sessions in that formality was abandoned, and the engineers in attendance discussed in round table fashion their particular problems.

Social functions included inspection and sightseeing trips, a welcome luncheon and speaker, an informal *Roundup* party, and the traditional *ASRE* dinner-dance on the final night of the meeting.

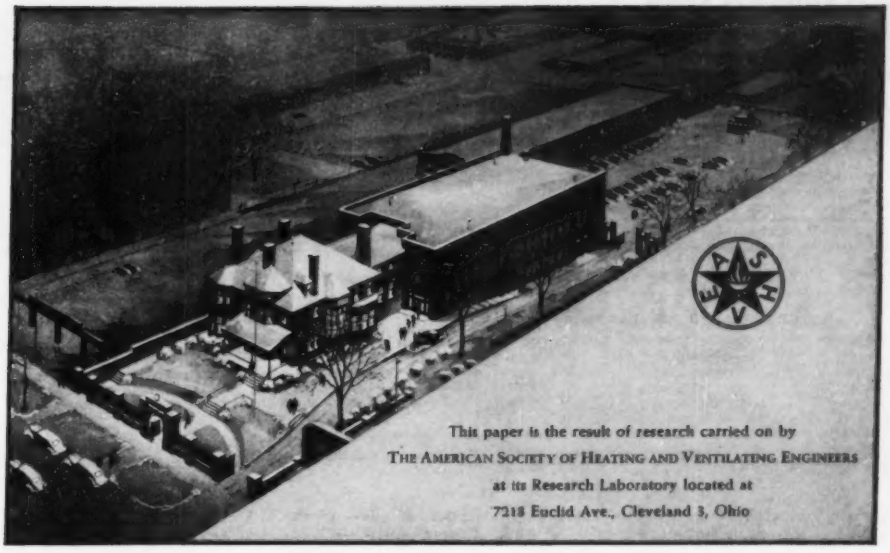
Arthur J. Hess, Los Angeles, was in charge of the technical program. M. W. Pehl, Kansas City, was chairman of the convention committee and arranged the social program. The Kansas City Section of *ASRE* acted as host for the meeting.

BUREAU OF STANDARDS ANNOUNCES NEW PUBLICATION

The National Bureau of Standards receives many inquiries from industry and other sources regarding the scope of its testing program, the type of tests it makes and the fees it charges for this service. A new circular, *Testing by the National Bureau of Standards*, has just been published which fully describes the Bureau's test policy, presents general information on testing, and lists fees for most of the test work that is done. This circular, C 483, is now available from the U.S. Government Printing Office, Washington, D. C., at 25 cents U.S. funds plus 9 cents to cover mailing charges.

MINE AIR CONDITIONING

Methods of controlling the chemical and physical qualities of underground air are discussed in the Bureau of Mines Information Circular 7528. The circular deals with theoretical and practical methods of conditioning air in mines to correct or alleviate health hazards and discusses the results attained by some of the systems now in use in various parts of the world. Mechanical refrigeration has been used to cool sweltering holes in less than a month whereas in the past air was sometimes blown through tunnels for three years to accomplish the same cooling effect.


This paper is the result of research carried on by
THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS
at its Research Laboratory located at
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Heat Flow Through Unshaded Glass

Design Data for Use in Load Calculations

By George V. Parmelee* and Warren W. Aubele**, Cleveland, Ohio

SUMMARY — Suggested design values of overall coefficients for heating load calculations are presented for flat glass and walls of hollow glass block. Tables of transmitted solar radiation and of convection and radiation gain are given for four types of single glass, four combinations of two sheets of glass, and six patterns of hollow glass block. These data are for summer design temperatures and for both clear and industrial atmospheric conditions.

THE PURPOSE of this research paper is to present data on heat flow through glass sections that will be useful in the determination of loads on heating systems in winter and cooling systems in summer. The data are based principally upon the results of a long-range research program which has been carried on at the ASHVE Research Laboratory in Cleveland under the direction of the Committee on Research and the Technical Advisory Committee on Heat Flow Through Glass.† These studies are a continuation of the pioneer investigations which were carried on at the Society's former Laboratory in Pittsburgh and have been reported in TRANSACTIONS, 1930 to 1941. Many of the basic data have already been given in recent ASHVE research reports.[1,2,3,4]

The data given in this report include: (1) overall coefficients of heat transmission for steady state heat flow through flat glass and glass block under winter conditions in the absence of solar radiation and (2) periodic heat flow through sunlit flat glass and glass block for four orientations at 40 deg north latitude on August 1.

Design Data

Design Conditions

The rate of heat flow through a glass panel is dependent upon the characteristics of a three-part system which consists of the glass section, the indoor environment, and the outdoor environment. The research carried on to date has resulted in the determination of basic thermal characteristics of glass sheets, assemblies of sheets, and walls of hollow glass block and mortar. Thermal characteristics here refer to the ability to conduct heat from one surface to another, the ability to transmit, absorb, reflect, and emit radiant energy and the ability to store heat. Geometrical characteristics such as surface roughness, size and installation details have a bearing on thermal behavior.

The setting up of design data presents the problem of determining what should be the design conditions for the indoor and outdoor environments. In spite of much work done in the analysis of weather data, outdoor design conditions are at present inadequately described with regard to their coincidental effect on heat flow at outdoor surfaces. Design conditions indoors are likewise incompletely described, because a statement of

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Exponent numerals refer to References.

For presentation at the Semi-Annual Meeting of THE AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, Muskoka, Ontario, Canada, June 1950.

Table 1—Coefficients of Heat Transmission, *U*, of Glass Sections

Coefficients are expressed in Btu per (hour) (square foot) (Fahrenheit degree difference in temperature between the air on the two sides), and are based on the following outdoor conditions: 0 F air temperature, clear skies, no solar radiation and a convection conductance of 4.0 Btu per (hr) (sq ft) (F deg difference in temperature).

Section A—Flat Glass

Number of Sheets	One	Two			Three		
Air Space, In.	..	¼	½	1	¼	½	1
U, Vertical	1.17	0.61	0.55	0.53	0.41	0.36	0.34
U, Horizontal Heat Flow Up	1.40	0.70	0.66	0.63	..	..	..

Section B—Walls of Hollow Glass Block[a]

Description[b]	Size of Block, In.	*U*
Types I and II	7¾×7¾×3⅞	0.55
Types I and II	5¾×5¾×3⅞	0.60
Types IV, IVA[c], V	7¾×7¾×3⅞	0.57
Type III	7¾×7¾×3⅞	0.48

[a] Values include mortar joint.
[b] See Table 2.
[c] Type IVA is the same as Type IV except external corrugations are vertical.

Section C—Application Factors for Windows
Multiply Flat Glass *U* Values by These Factors

Window Description	Single Glass		Double Glass[d]		Windows with Storm Sash	
	Percent Glass	Factor	Percent Glass	Factor	Percent Glass	Factor
Sheets	100	1.00	100	1.00		
Wood Sash	80	0.90	80	0.95	80	0.90
Wood Sash	60	0.80	60	0.85	60	0.80
Metal Sash	80	1.00	80	1.20	80	1.00[e]

[d] Unit type double glazing, two lights or panes in same sash.
[e] Metal storm sash or auxiliary glass pane indoors.

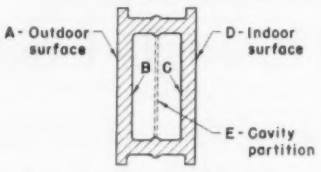
the indoor air temperature and humidity to be maintained does not specify the heat exchange between the room and the indoor surface nor the thermal storage characteristics of the structure. Furthermore, for the same season and location, design conditions are different for structures of different types and uses.

Hence, in the absence of more specific data on boundary heat transfer characteristics for design conditions, it has been necessary to select a combination of factors that might be expected to apply in many practical cases. Because methods of relating heating or cooling *loads* to instantaneous rates of heat flow are not yet fully developed, the tables of data presented herewith give only *instantaneous rates of heat flow.*

Overall Coefficients

Design values of the overall coefficient of heat transmission, *U*, in Btu per (hour) (square foot) (Fahrenheit degree difference between indoor and outdoor air temperatures) have been computed for flat glass and hollow glass block and are given in Table 1. The glass block patterns are described in Table 2. The design conditions are based upon experimental work carried on by the ASHVE Research Laboratory and by others[5,6] and are described in detail in Appendix A. No serious error will be involved if the values are used for air temperatures within 10 to 15 deg of zero.

Table 2—Description of Glass Block Patterns



Elevation Section of Hollow Glass Block to Indicate Location of Surface Patterns

Type I —Smooth Face
A, D: Smooth
B: Wide vertical ribs or flutes
C: Wide horizontal ribs or flutes
E: None
Type II —Semi-Light Diffusing
A, D: Narrow vertical ribs or flutes
B, C: Etched or stippled
E: None
Type III—Light Diffusing
A, D: Narrow vertical ribs or flutes
B, C: Etched or stippled
E: Glass fiber screen
Type IV—Light Diffusing
A, D: Close pitch deep horizontal corrugations
B, C: Vertical light diffusing prisms
E: None
Type V —Light Directing
A, D: Close pitch deep vertical corrugations
B, C: Horizontal light directing prisms
E: None

The method of computing the values is given in Appendices B and C.

The data in Section A of Table 1 are applicable to glass sheets only. Section C gives approximate factors by which the Section A values are multiplied to obtain values for windows. The area to be used is the projected area of the glass and exposed sash.

Later in this report the coefficients given in Table 1 are compared with test results, and values for other conditions are presented.

Table 3—Description of Flat Glass

Glass No.	Fraction of Normally Incident Solar Radiation Transmitted	Commercial Type Glass
A	0.85—0.90	Ordinary window, High transmission plate
B	0.75—0.80	Regular plate
C	0.37—0.42	Heat absorbing
D	0.20—0.25	Heat absorbing

Heat Flow Through Sunlit Glass

Instantaneous rates of heat gain due to transmitted direct and diffuse solar radiation for flat glass types, described in Table 3, are listed in Tables 4 and 6. Instantaneous rates of heat gain due to temperature difference and absorbed solar radiation are listed separately in Tables 5 and 7. Tables 8, 9, 10 and 11 give similar data for walls of eight-inch square hollow glass block. These tables are for 40 deg north latitude on August 1 (18 deg declination, north). In each case the total heat flow is the sum of the transmitted solar radiation and the convection and radiation gain, that is, Table 4 values are added to Table 5 values and so on.

Tables 4, 5, 8, and 9 may be considered as applicable to localities having relatively clear atmospheres, while Tables 6, 7, 10 and 11 are applicable to humid industrialized areas. Local conditions should be investigated fully before selecting a table for design use. The tabular values of Tables 5, 7, 9, and 11 are based upon an outdoor design dry bulb temperature of 95 F maximum and an indoor temperature of 75 F dry bulb. The solar intensity values for a clear atmosphere (Table 12)

Table 4—Instantaneous Rates of Heat Gain Due to Transmitted Direct and Diffuse Solar Radiation by Vertical Unshaded Flat Glass

For clear atmospheres (see Table 12) on August 1 (18 deg declination, north) and 40 deg north latitude.
For total instantaneous heat gain add these values to Table 5 values

Instantaneous Heat Gain for Single Sheets in Btu per (hr) (sq ft)

Sun Time	Glass A				Glass B				Glass C				Glass D			
A.M.	N	E	S	W	N	E	S	W	N	E	S	W	N	E	S	W
5 7	3	7	1	0	2	6	0	0	1	3	0	0	1	2	0	0
6 6	24	133	8	7	20	114	7	6	10	61	4	4	5	32	2	2
7 5	13	198	14	12	11	168	12	10	6	91	7	6	3	47	4	3
8 4	12	211	22	15	10	177	18	13	6	94	11	7	3	48	6	4
9 3	13	186	48	18	11	154	39	15	6	81	21	9	4	42	11	5
10 2	14	133	76	20	12	110	62	16	7	56	32	10	4	28	16	5
11 1	14	64	96	21	12	52	79	18	7	31	40	10	4	14	20	6
12	14	22	104	22	12	18	85	18	7	11	44	11	4	6	22	6
P.M.	N	W	S	E	N	W	S	E	N	W	S	E	N	W	S	E

Instantaneous Heat Gain for Two Sheets[a] in Btu per (hr) (sq ft)

Sun Time	Glass A+A				Glass B+B				Glass C+B[b]				Glass C+C			
A.M.	N	E	S	W	N	E	S	W	N	E	S	W	N	E	S	W
5 7	2	6	0	0	2	4	0	0	1	3	0	0	1	2	0	0
6 6	19	120	7	6	13	90	6	5	7	52	3	3	5	36	3	2
7 5	11	177	13	11	8	133	10	8	5	76	6	5	3	53	4	4
8 4	11	188	18	13	8	139	14	10	5	80	8	6	4	55	6	5
9 3	12	165	36	15	9	120	26	12	5	69	15	7	4	46	10	5
10 2	12	115	62	17	10	83	44	13	5	47	24	8	4	30	16	6
11 1	13	51	81	18	10	35	57	14	6	20	32	8	4	13	20	6
12	13	19	88	19	10	15	62	15	6	9	35	9	4	7	22	7
P.M.	N	W	S	E	N	W	S	E	N	W	S	E	N	W	S	E

[a]Spaced at ¼ in. [b]Glass C is outdoor sheet.

Table 5—Instantaneous Rates of Heat Gain by Convection and Radiation from Vertical Unshaded Flat Glass

For clear atmospheres (see Table 12) on August 1 (18 deg declination, north) and 40 deg north latitude
For 75 F Indoor Temperature
For total instantaneous heat gain add these values to Table 4 values

Instantaneous Heat Gain for Single Sheets in Btu per (hr) (sq ft)

Sun Time	Dry Bulb	Glass A				Glass B				Glass C				Glass D			
	F	N	E	S	W	N	E	S	W	N	E	S	W	N	E	S	W
5 a.m.	74	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1
6	74	−1	0	−1	−1	1	4	−1	−1	4	15	0	0	5	21	1	1
7	75	0	2	0	0	1	9	1	1	3	30	2	2	4	43	3	3
8	77	2	3	2	2	3	13	3	3	4	40	4	5	5	57	5	6
9	80	5	6	6	5	6	17	7	6	7	47	11	8	8	65	12	9
10	83	9	10	10	9	10	20	12	10	11	45	20	12	12	57	23	13
11	87	13	14	14	13	14	21	19	14	15	34	31	16	16	39	36	17
12	90	17	17	18	17	18	20	24	18	20	22	40	20	21	24	46	22
1 p.m.	93	20	20	21	21	21	21	29	23	23	24	45	27	24	25	52	30
2	94	22	22	22	23	23	23	30	28	25	25	44	40	26	26	51	47
3	95	23	23	23	24	24	24	29	33	25	26	37	52	26	27	40	64
4	94	22	22	22	23	23	23	24	34	24	25	28	60	25	26	30	76
5	93	20	20	20	22	21	21	21	32	22	23	23	61	23	24	24	78
6	91	18	17	18	19	20	18	18	27	23	19	20	50	25	20	20	63
7	87	13	13	13	13	13	13	13	14	14	13	13	15	14	13	13	15
8	85	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
9	83	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8

Instantaneous Heat Gain for Two Sheets[a] in Btu per (hr) (sq ft)

Sun Time	Dry Bulb	Glass A+A				Glass B+B				Glass C+B[b]				Glass C+C			
	F	N	E	S	W	N	E	S	W	N	E	S	W	N	E	S	W
5 a.m.	74	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	1
6	74	0	1	−1	−1	1	6	0	0	3	8	0	0	3	17	0	0
7	75	0	3	0	0	2	15	1	1	3	20	1	1	3	35	2	2
8	77	1	4	1	1	2	25	2	2	3	30	2	3	3	45	5	4
9	80	3	6	4	3	4	31	4	4	5	36	6	5	5	49	9	6
10	83	5	7	6	5	6	30	8	6	7	34	12	7	7	42	15	8
11	87	7	9	9	7	8	24	16	8	10	27	20	9	10	30	25	10
12	90	10	10	11	9	11	12	22	10	12	14	26	11	12	15	32	12
1 p.m.	93	12	12	13	12	13	13	26	13	14	14	30	15	14	15	36	19
2	94	12	12	14	15	13	14	28	20	15	15	31	22	15	16	35	30
3	95	13	13	14	16	14	15	25	27	15	15	27	33	15	16	30	47
4	94	12	12	13	16	13	14	19	34	14	14	20	40	14	15	23	57
5	93	12	12	12	15	13	13	14	36	13	13	15	44	13	14	16	58
6	91	11	10	10	12	13	11	11	28	14	11	11	36	14	12	12	45
7	87	7	7	7	7	7	7	7	9	8	7	7	9	8	7	7	10
8	85	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
9	83	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

[a]Spaced at ¼ in. [b]Glass C is outdoor sheet.

Table 6—Instantaneous Rates of Heat Gain Due to Transmitted Direct and Diffuse Solar Radiation by Vertical Unshaded Flat Glass

For industrial atmospheres (see Table 13) on August 1 (18 deg declination, north) and 40 deg north latitude
For total instantaneous heat gain add these values to Table 7 values

Instantaneous Heat Gain in Btu per (hr) (sq ft)

Sun Time	Glass A				Glass B				Glass C				Glass D			
A.M.	N	E	S	W	N	E	S	W	N	E	S	W	N	E	S	W
5 7	2	5	0	1	1	4	0	1	1	2	0	0	0	1	1	0
6 6	15	75	8	6	14	63	7	5	7	35	4	3	3	18	2	2
7 5	14	135	16	12	12	115	13	10	7	63	8	6	4	33	4	3
8 4	16	149	24	17	13	125	20	14	8	68	12	8	4	35	6	5
9 3	17	138	43	21	15	115	35	17	8	61	19	10	5	32	10	6
10 2	18	104	63	24	15	85	52	20	9	49	28	12	5	23	14	6
11 1	18	57	78	26	15	47	64	22	9	28	34	13	5	13	18	7
12	18	29	84	29	15	25	69	25	9	14	36	14	5	8	19	8
P.M.	N	W	S	E	N	W	S	E	N	W	S	E	N	W	S	E

Instantaneous Heat Gain for Two Sheets[a] in Btu per (hr) (sq ft)

Sun Time	Glass A+A				Glass B+B				Glass C+B[b]				Glass C+C			
A.M.	N	E	S	W	N	E	S	W	N	E	S	W	N	E	S	W
5 7	2	5	0	1	1	3	0	1	1	2	0	0	0	1	0	0
6 6	12	67	7	5	8	50	6	4	5	28	3	2	3	21	3	2
7 5	12	121	14	10	9	90	11	8	5	52	6	5	4	37	5	4
8 4	14	133	21	15	11	99	16	12	6	57	9	7	5	40	7	5
9 3	15	123	34	18	12	90	25	14	7	52	14	8	5	36	10	6
10 2	15	90	52	21	12	65	38	16	7	37	21	9	5	25	14	7
11 1	16	46	67	23	12	33	48	18	7	19	27	10	5	13	18	8
12	16	26	72	26	12	20	52	20	7	11	29	11	5	9	19	9
P.M.	N	W	S	E	N	W	S	E	N	W	S	E	N	W	S	E

[a]Spaced at ¼ in. [b]Glass C is outdoor sheet.

Table 7—Instantaneous Rates of Heat Gain by Convection and Radiation from Vertical Unshaded Flat Glass

For industrial atmospheres (see Table 13) on August 1 (18 deg declination, north) and 40 deg north latitude
For 75 F Indoor Temperature
For total instantaneous heat gain add these values to Table 6 values

Sun Time	Dry Bulb	Instantaneous Heat Gain for Single Sheets in Btu per (hr) (sq ft)															
		Glass A				Glass B				Glass C				Glass D			
	F	N	E	S	W	N	E	S	W	N	E	S	W	N	E	S	W
5 a.m.	74	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1
6	74	−1	−1	−1	−1	0	1	−1	−1	2	7	0	0	3	10	1	0
7	75	0	1	0	0	1	5	1	1	3	20	2	2	5	28	3	2
8	77	+2	2	+2	+2	3	10	3	3	5	30	5	5	6	40	6	6
9	80	5	6	6	5	6	15	7	6	8	36	9	9	9	48	11	10
10	83	9	9	9	9	10	18	12	10	12	36	17	13	13	46	21	14
11	87	13	14	14	13	14	19	18	15	16	31	27	17	17	37	32	18
12	90	17	17	17	17	18	19	22	18	20	24	34	21	21	26	40	23
1 p.m.	93	20	20	21	21	21	22	26	22	23	25	39	26	25	27	45	28
2	94	22	22	22	23	23	23	27	26	25	26	40	35	27	27	45	41
3	95	23	23	23	24	24	24	27	29	26	26	36	45	27	28	38	53
4	94	22	22	22	23	23	23	24	30	24	25	29	48	26	26	31	60
5	93	20	20	20	21	21	21	21	29	22	23	24	47	23	23	24	59
6	91	18	18	18	18	19	18	18	23	21	19	19	35	22	19	19	43
7	87	13	13	13	13	13	13	13	13	14	13	13	14	14	13	13	15
8	85	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11
9	83	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8

Sun Time	Dry Bulb	Instantaneous Heat Gain for Two Sheets[a] in Btu per (hr) (sq ft)															
		Glass: A+A				Glass: B+B				Glass: C+B[b]				Glass: C+C			
	F	N	E	S	W	N	E	S	W	N	E	S	W	N	E	S	W
5 a.m.	74	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1	−1
6	74	−1	0	−1	−1	1	2	0	0	1	4	0	0	2	9	0	0
7	75	0	1	0	0	2	10	1	1	2	13	2	1	3	22	2	1
8	77	+1	2	+1	+1	2	17	2	3	3	21	3	3	4	31	3	4
9	80	3	4	4	4	4	23	4	4	5	27	6	5	6	35	8	6
10	83	5	6	6	5	6	24	8	7	7	28	10	8	8	33	14	9
11	87	8	9	9	8	9	21	14	9	10	24	16	9	11	26	21	11
12	90	10	10	11	10	11	14	20	11	12	16	22	12	13	17	27	14
1 p.m.	93	12	12	13	13	13	14	24	14	14	15	26	15	15	16	31	18
2	94	13	13	14	14	14	14	24	16	15	16	27	19	15	17	31	25
3	95	13	13	14	15	15	15	23	23	15	16	24	27	16	17	27	36
4	94	13	13	13	15	14	14	19	26	14	15	14	31	15	16	21	42
5	93	12	12	12	14	12	12	13	25	13	13	14	30	13	14	15	42
6	91	10	10	10	11	12	10	12	22	13	11	12	25	13	11	13	29
7	87	7	7	8	7	7	7	9	11	8	7	9	11	8	7	10	11
8	85	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
9	83	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5	5

[a] Spaced at ¼ in.

[b] Glass C is outdoor sheet.

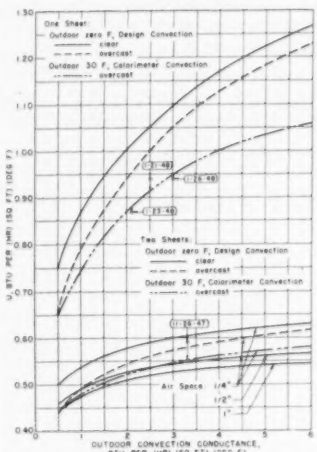


Fig. 1—Influence of outdoor environment on *U* values for vertical flat sheets of glass and comparison with test results

are based upon Moon's[7] suggested standard curve. This curve is practically identical with values derived from recommended design sol-air data[8] for Lincoln, Neb. The values for an industrial atmosphere (Table 13) were derived from design sol-air data[9] for New York City. The solar radiation data are discussed further in Appendix A. The calculation procedures followed in setting up the tables are discussed fully in Appendices A, B, and C and will be of interest to those who desire to work out values for other conditions and locations.

A surface conductance of 4.0 Btu per (hr) (sq ft) (F deg) has been used in computing heat transfer between the outdoor environment and the outdoor surface of glass panels. This includes convection and all radiation exchanges, and hence is an approximation. It is, however, consistent with present practice in estimating heat gain through sunlit walls and roofs.

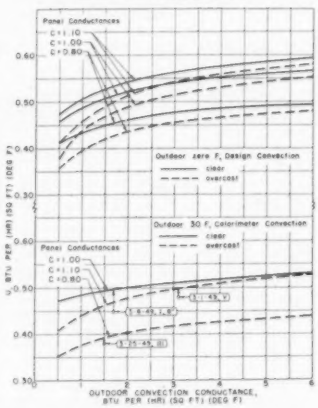


Fig. 2—Influence of outdoor environment on *U* values for glass block walls and comparison with test results

Table 8—Instantaneous Rates of Heat Gain Due to Transmitted Direct and Diffuse Solar Radiation by Walls of Hollow Glass Block

For clear atmospheres (see Table 12) on August 1 (18 deg declination, north) and 40 deg north latitude
For total instantaneous heat gain add these values to Table 9 values

Sun Time	Instantaneous Heat Gain in Btu per (hr) (sq ft)																					
	Glass Block No. I				Glass Block No. II				Glass Block No. III				Glass Block No. IV			Glass Block No. IVA			Glass Block No. V			
A.M.	N	E	S	W	N	E	S	W	N	E	S	W	E	S	W	E	S	W	E	S	W	
5 7	0	3	0	0	0	3	0	0	0	2	0	0	1	0	0	1	0	0	1	0	0	
6 6	4	66	3	2	4	64	3	2	3	44	2	2	24	2	1	24	2	1	22	2	1	
7 5	3	97	5	4	3	89	5	4	3	58	3	3	33	3	2	39	3	2	37	3	2	
8 4	4	90	6	5	4	78	6	5	3	52	5	4	26	4	3	39	4	3	58	4	3	
9 3	4	59	11	6	4	50	10	6	3	37	7	4	16	6	3	37	5	3	53	6	3	
10 2	5	28	16	6	5	28	15	6	3	21	10	5	10	8	4	24	9	4	31	13	4	
11 1	5	14	18	7	5	13	18	7	3	9	14	5	7	8	4	9	17	4	10	18	4	
12	5	7	17	7	5	7	17	7	3	5	15	5	4	8	4	4	20	4	4	20	4	
P.M.	N	W	S	E	N	W	S	E	N	W	S	E	W	S	E	W	S	E	W	S	E	

Discussion of New Data

Overall Coefficients

In Part I of ASHVE RESEARCH BULLETIN No. 1, Heat Transmission through Glass,[10] the literature dealing with overall coefficients is reviewed. In the summary of this review, it was stated that differences in the results of investigators who tested what appeared to be similar or identical installations can be attributed to differences in the degree of circulation of air in the test en-

Table 9—Instantaneous Rates of Heat Gain by Convection and Radiation from Sunlit Walls of Hollow Glass Block

For clear atmospheres (see Table 12) on August 1 (18 deg declination, north) and 40 deg north latitude

For 75 F Indoor Temperature

For total instantaneous heat gain add these values to Table 8 values

Sun Time	Instantaneous Heat Gain in Btu per (hr) (sq ft)											
	Dry Bulb	Glass Block Nos. I, II				Glass Block No. III				Glass Block Nos. IV, IVA, V		
	F	N	E	S	W	N	E	S	W	E	S	W
5 a.m.	74	0	0	0	0	0	0	0	0	0	0	0
6	74	2	6	0	0	2	10	0	0	10	0	0
7	75	3	19	1	1	3	26	1	1	27	1	1
8	77	2	28	3	2	2	37	3	2	38	4	2
9	80	2	35	7	4	2	38	7	4	41	7	4
10	83	4	38	14	6	4	37	14	6	40	14	6
11	87	6	31	21	8	6	31	21	8	33	21	8
12	90	8	18	25	10	8	18	24	10	20	26	10
1 p.m.	93	10	16	28	14	10	16	27	14	17	28	13
2	94	11	17	27	30	11	17	26	29	18	28	28
3	95	13	18	23	43	13	18	22	41	19	25	41
4	94	13	17	18	46	13	17	17	50	18	19	51
5	93	13	15	15	44	13	15	15	53	17	15	55
6	91	15	13	13	37	15	13	13	45	15	13	49
7	87	13	10	10	23	13	10	10	27	10	10	30
8	85	9	6	6	9	9	6	6	9	6	7	11
9	83	9	4	4	6	6	4	4	6	4	4	7

Table 11—Instantaneous Rates of Heat Gain by Convection and Radiation from Sunlit Walls of Hollow Glass Block

For industrial atmospheres (see Table 13) on August 1 (18 deg declination, north) and 40 deg north latitude

For 75 F Indoor Temperature

For total instantaneous heat gain add these values to Table 10 values

Sun Time	Instantaneous Heat Gain in Btu per (hr) (sq ft)											
	Dry Bulb	Glass Block Nos. I, II				Glass Block No. III				Glass Block Nos. IV, IVA, V		
	F	N	E	S	W	N	E	S	W	E	S	W
5 a.m.	74	0	0	0	0	0	0	0	0	0	0	0
6	74	1	3	0	0	1	5	0	0	5	0	0
7	75	2	11	1	1	2	16	1	1	16	1	1
8	77	2	19	3	2	2	25	3	2	25	3	2
9	80	3	25	5	4	3	28	5	4	29	5	4
10	83	4	28	11	6	4	28	11	7	29	11	7
11	87	6	25	17	8	6	24	17	10	26	17	9
12	90	8	17	22	10	8	18	22	12	19	22	11
1 p.m.	93	10	17	25	13	10	17	25	14	18	25	13
2	94	12	18	25	23	12	18	25	24	19	25	23
3	95	13	19	21	33	13	19	22	33	19	23	32
4	94	14	18	17	36	14	18	18	38	18	18	40
5	93	13	17	15	35	13	17	16	38	17	16	41
6	91	14	14	13	28	14	14	13	30	14	14	35
7	87	11	10	10	18	11	10	10	17	10	11	22
8	85	8	6	7	9	8	6	7	9	6	7	10
9	83	5	4	4	6	5	4	4	6	4	4	6

closure, in the emissive character of the hot box surfaces, and in the mean temperature and air-to-air temperature difference.

These explanations, which are concerned with the characteristics of the indoor and outdoor environment, apply here.

Fig. 1 shows the influence of the outdoor environment on values of *U* for flat glass with the outdoor temperature at 0 F and the indoor conditions held constant. Also shown are curves for indoor and outdoor conditions comparable to those in tests made with the calorimeter apparatus and previously reported.[3]

It should be noted that indoor surface conductances for the calorimeter, for combined radiation and convection, are of the order of 1.20 as compared to 1.40 to 1.50 Btu per (hr) (sq ft) (F deg) for design conditions. Test points are shown directed to the appropriate curves. These points were located along the abscissa in accordance with the convection conductances computed from flat plate tests.[11] The point for double glass is high because the sky was not completely overcast. No measurements of radiation received from the outdoor surroundings were made in these tests.

Table 10—Instantaneous Rates of Heat Gain Due to Transmitted Direct and Diffuse Solar Radiation by Walls of Hollow Glass Block

For industrial atmospheres (see Table 13) on August 1 (18 deg declination, north) and 40 deg north latitude

For total instantaneous heat gain add these values to Table 11 values

Sun Time	Instantaneous Heat Gain in Btu per (hr) (sq ft)																			
	Glass Block No. I				Glass Block No. II				Glass Block No. III				Glass Block No. IV			Glass Block No. IVA			Glass Block No. V		
A.M. ↓	N	E	S	W	N	E	S	W	N	E	S	W	E	S	W	E	S	W	E	S	W
5 7	0	3	0	0	0	2	0	0	0	2	0	0	1	0	0	1	0	0	1	0	0
6 6	3	35	3	2	3	34	3	2	2	23	2	1	13	2	1	13	2	1	13	2	1
7 5	4	63	5	4	4	59	5	4	3	38	4	3	23	3	2	27	3	2	25	3	2
8 4	5	61	7	6	5	55	7	6	4	36	5	4	20	4	3	27	4	3	39	4	3
9 3	6	44	11	7	6	38	10	7	4	29	7	5	14	6	4	28	6	4	37	7	4
10 2	6	24	15	8	6	24	14	8	4	18	10	6	10	8	4	19	9	4	23	11	5
11 1	6	14	17	9	6	14	17	9	4	10	13	6	7	8	5	9	14	5	10	15	5
12	6	10	17	10	6	10	17	10	4	7	14	7	5	8	5	5	16	5	6	16	6
↑ P.M.	N	W	S	E	N	W	S	E	N	W	S	E	W	S	E	W	S	E	W	S	E

The results of recent hot box tests, some of which were cited as reference material in an ASHVE paper,[3] are in good agreement with the curves of Fig. 1 for overcast skies. The radiation characteristics of the out-of-doors with overcast skies are closely comparable to conditions in the hot box tests, since the hot box surfaces were covered with non-reflective materials. The values in Table 1 therefore appear to be reasonable and are recommended for use in place of the present values[12] of 1.13, 0.45, and 0.26 Btu per (hr) (sq ft) (F deg) for single, double and triple glass respectively.

The factors for windows were derived from data reported in Bulletin No. 1[10] by comparing *U* values for sheets of glass with *U* values for windows. Each comparison was made between tests performed in the same hot box under identical conditions.

The suggested coefficients for glass block, except for Type III, are 10 to 20 percent higher than published values[13] of 0.49 and 0.46 for smooth and ribbed faced block respectively. Reference 24 in Bulletin No. 1,[10] from which these values were derived, shows that both had *U* values of 0.43 when tested under identical conditions of low air velocity and low emissivity box surfaces.

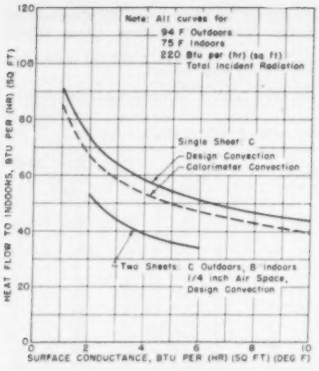

Note: All curves for
94 F Outdoors
75 F Indoors
220 Btu per (hr) (sq ft)
Total Incident Radiation
Single Sheet: C
Design Convection
Calorimeter Convection
Two Sheets: C Outdoors, B Indoors
1/4 inch Air Space,
Design Convection
HEAT FLOW TO INDOORS, BTU PER (HR) (SQ FT)
SURFACE CONDUCTANCE, BTU PER (HR) (SQ FT) (DEG F)

Fig. 3—Influence of outdoor surface conductance on convection and radiation heat gain from sunlit glass

This value was adjusted to design conditions of 15 mph by empirical formulas for surface conductances. Inspection of the data will show that the panel conductances, based on panel surface temperatures, were 1.00 and 1.05 Btu per (hr) (sq ft) (F deg) for the panels of smooth and ribbed faced block respectively. These compare favorably with 0.98 and 1.09 found in the calorimeter tests[4], on which the Table 1 values were based. The differences between the *U* values therefore are due to the characteristics of the indoor and outdoor environments.

Fig. 2 shows the influence of the outdoor environment on *U* values for glass block walls and compares test data with calculated curves. Except for the Type I block, the points are in good agreement with the curves. In the test of this block

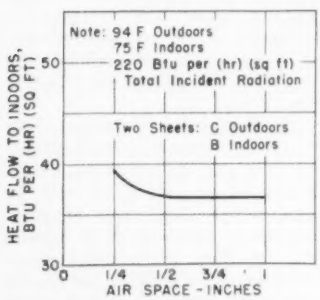

Note: 94 F Outdoors
75 F Indoors
220 Btu per (hr) (sq ft)
Total Incident Radiation
Two Sheets: C Outdoors
B Indoors
HEAT FLOW TO INDOORS, BTU PER (HR) (SQ FT)
AIR SPACE - INCHES

Fig. 4—Influence of air space width on convection and radiation heat gain from sunlit glass

the radiant energy contribution from the surroundings was 7 Btu per (hr) (sq ft) in excess of that used for design purposes. Allowance for this will place the test point within 2 percent of the curve.

Heat Flow Through Sunlit Flat Glass

For purposes of standardization in making up Tables 4, 5, 6, and 7, each set of values was computed for a glass of definite solar energy transmitting characteristics (see Appendix C). In practice the transmitting characteristics of a given type of glass are variable. Hence each set of values has been designated as being applicable to any glass that has a transmittance which falls within the range indicated in Table 3. Over such a range the sum of the transmittance and absorptance is approximately constant, so that the *total* heat flow is substantially constant. The division between gain from transmitted solar energy and that from convection and radiation gain is, however, altered.

It will be noted that glasses C and D, termed heat absorbing glasses, cause a marked reduction in the transmitted solar energy as compared with glasses A and B. This reduction is accompanied by a considerable increase in convection and radiation heat gain. As shown in Fig. 3 environmental conditions significantly affect the convection and radiation heat gain.

The convection and radiation gains for two sheets of glass are for one-quarter inch spacing. An analytical investigation was made to determine the effect of air space for the combination of glasses B and C at the period of peak heat gain. The results, shown in Fig. 4, indicate that air space widths between one-quarter inch and one inch have no important influence. Spacing affects transmitted radiation only to the extent that the setback shades the inner sheet. This is significant at high angles of incidence.

Heat Gain Through Sunlit Glass Block

The heat gain data for sunlit glass block are principally new data.

Table 12—Design Values of Solar Radiation Received by Various Oriented Surfaces in Btu per (hr) (sq ft) for Clear Atmospheres

Solar Altitude Deg	Direct Radiation[a]	Diffuse[b] or Sky Solar Radiation Received by Walls and a Horizontal Surface				
A.M. → ↓	Normal to Sun	N	E	S	W	Hor.
5	67	4	9	4	4	7
10	123	7	18	9	8	14
15	166	10	24	13	11	19
20	197	12	28	16	13	23
25	218	13	31	18	15	26
30	235	14	33	21	17	28
35	248	15	34	23	18	30
40	258	15	34	25	20	31
45	266	16	34	26	21	32
50	273	16	33	28	23	33
60	283	17	31	29	25	34
70	289	17	26	30	26	35
↑ P.M. →	Normal to Sun	N	W	S	E	Hor.

[a]Moon's[7] proposed standard for sea level, 20 mm precipitable water vapor, 300 dust particles per cu cm., 2.8 mm Hg partial pressure of ozone.
[b]For 40 deg north latitude on about August 1.

Table 13—Design Values of Solar Radiation Received by Variously Oriented Surfaces in Btu per (hr) (sq ft) for Industrial Atmospheres

Solar Altitude Deg	Direct Radiation[a]	Diffuse[b] or Sky Solar Radiation Received by Walls and a Horizontal Surface				
A.M. → ↓	Normal to Sun	N	E	S	W	Hor.
5	34	4	11	5	3	9
10	58	8	22	9	7	18
15	80	11	28	13	9	24
20	103	13	36	17	12	31
25	121	16	43	21	16	38
30	136	18	47	24	18	44
35	148	19	50	27	21	48
40	158	20	50	30	23	52
45	165	21	49	31	25	55
50	172	22	47	34	27	58
60	181	22	41	37	30	63
70	188	22	34	41	34	69
↑ P.M. →	Normal to Sun	N	W	S	E	Hor.

[a]Derived from recommended design sol-air temperatures[8] for a horizontal surface with absorptivity of 1.0 for New York City.
[b]For 40 deg north latitude on about August 1.

Table 14—Corrections to Tables 5, 7, 9 and 11 for Indoor and Outdoor Temperature

For each degree the design room temperature exceeds 75 F, subtract correction. For each degree the design outdoor dry bulb temperature exceeds 95 F, add correction. Apply the corrections to each value in the appropriate table

Glass Area	Correction Btu (hr) (sq ft)
Single Glass	1.0
Double Glass	0.6
Glass Block (Types I, II, IV, V)	0.5
Glass Block (Type III)	0.4

ASHVE RESEARCH REPORT No. 1147[13] gives the results of an investigation of the heat flow characteristics of two of the types for which data are given in this paper, Type I and Type V. Data on a third type, similar to Type I, were also given. Design data were given for Type I for east, south and west walls and for Type V for south facing walls. It is values for the former that have been given in the HEATING, VENTILATING, AIR CONDITIONING GUIDE 1941 to 1950. The data presented in this report therefore represent a considerable extension of earlier work.

Application of Data

Overall Coefficients

The values presented in Table 1 are applicable to most cases encountered in estimating heating loads. However, unusual conditions of either air motion or radiant energy exchange or both should be examined carefully to determine whether or not they deviate greatly from the design conditions. Figs. 1 and 2 take into account most variations in outdoor conditions. Heat flow calculations for greenhouses and sun rooms and for rooms in which there is unusual air motion in the vicinity of the indoor glass surfaces must be based upon a careful analysis of the situation. In the absence of field data related to convection and radiation exchanges in such cases, no application factors can be given at this time.

Solar Heat Gain

In the past three years, a considerable amount of solar radiation data has been collected during the course of test work. While no correlation of the data with other weather conditions has yet been attempted, some comments of a general nature may be helpful in selecting the proper radiation data to use for design purposes. It has been observed in Cleveland that solar intensity values of the order of those given for industrial atmospheres, are usually associated with dry bulb and wet bulb temperatures near the design values of 95 F and 75 F (67 F dewpoint). On the other hand, values equal to or exceeding the suggested values for a clear atmosphere are often encountered during Cleveland summers, but almost always with the dry bulb 10 to 15 deg below the design value and the dewpoint temperatures at about 55 F.

Therefore, although the values for humid industrial atmospheres will be applicable to many cities for summer *design conditions*, the possibility should not be overlooked that rooms having sun exposures may have peak loads on days when temperatures are well below design values. The total plant capacity may be entirely adequate, but the room distribution system may be grossly under-designed if proper consideration is not given to sun loads under these conditions.

If it is desired to use Tables 5, 7, 9 and 11 for other indoor temperatures, approximate corrections can be made according to Table 14.

It is beyond the scope of this paper to treat the problem of translating instantaneous rates of heat flow into apparatus loads. Because both transmitted solar energy and radiant energy from the indoor glass surfaces are absorbed by the indoor surfaces to become stored energy or to enter the air stream by convection from these surfaces, apparatus loads are lower than instantaneous rates of heat gain. In an air cooled room, only the heat convected from the glass becomes an instantaneous load. Under the design conditions used in this paper, this quantity is about one-third of the convection and radiation gains. The reader is referred to recent papers by C. O. Mackey[14] and C. S. Leopold [15, 16] for studies of this problem.

Acknowledgment

The authors acknowledge with thanks the suggestions and assistance given by the members of the Technical Advisory Committee on Heat Flow Through Glass and by their colleagues of the ASHVE Research Laboratory staff in preparing this paper.

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18. See p. 268 of Reference 12.

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APPENDIX A

Design Conditions

Indoor Design Conditions

It is assumed that all room surfaces seen by the indoor surface of the glass are at the temperature of the room air. Convection heat transfer between the air and glass surfaces is assumed to follow the equation:

$$h = C\Delta t^{0.25} \quad \text{.....(A-1)}$$

where

h = surface conductance for natural convection, Btu per (hour) (square foot) (Fahrenheit degree).

t = temperature difference between glass surface and room air, Fahrenheit degrees.

C = a constant: 0.27 for vertical surfaces, 0.38 for horizontal with heat flow upward.[5]

Because the emissivity of ordinary room surfaces is of the order of 0.90 to 0.95 for low temperature radiation and because the ratio of the room surface area to glass area is large, the indoors has been treated as a black body. The emissivity of glass in these calculations is taken as 0.938[17]. With these conditions and 0 F outdoors, the surface conductances for combined radiation and convection vary from about 1.55 Btu per (hr) (sq ft) (F deg) with low glass temperatures to about 1.40 at glass temperatures within 10 deg of room temperature. For sunlit glass under summer conditions surface conductances vary from about 1.00 Btu per (hr) (sq ft) (F deg) at sunrise to 1.80 (for glass D facing west, at the time of peak heat gain).

A room temperature of 70 F has been used in calculating the U values, but the resulting coefficients are applicable to any temperature in the comfort zone.

All heat gain data for sunlit glass are based upon an indoor temperature of 75 F.

Outdoor Design Conditions: Overall coefficients

For the computation of overall coefficients the design outdoor air temperature has been taken as 0 F. This temperature level affects both the indoor surface conductance and the radiation exchange with outdoor surroundings. Higher air temperature leads to higher overall coefficients of heat transfer, so that with a 30 F outdoor temperature the U value for single glass at design convection conditions outdoors is 1.20 as compared to 1.17 Btu per (hr) (sq ft) (F deg) at 0 F, and 0.65 for double glass with quarter-inch air space as compared to 0.61.

Because peak load conditions normally occur at night the influence of solar radiation has been considered nil. However, the basic data are available for computing its effect. Appendix C presents a method of computing heat gain or loss due to the combined effect of temperature difference and absorbed solar radiation.

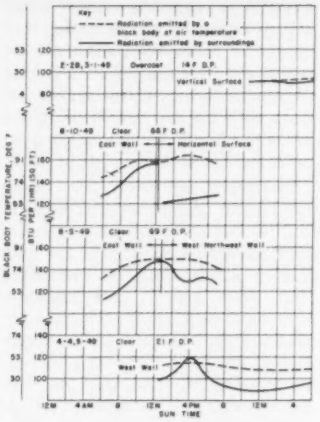
Key
Radiation emitted by a black body at air temperature
Radiation emitted by surroundings
2-28, 3-1-49 Overcast 14 F D.P.
Vertical Surface
8-10-49 Clear 66 F D.P.
East Wall
Horizontal Surface
8-5-49 Clear 69 F D.P.
East Wall
West Northwest Wall
4-4,5-49 Clear 61 F D.P.
West Wall
BLACK BODY TEMPERATURE, DEG F
RADIATION, BTU PER (HR) (SQ FT)
12M 4AM 8 12N 4PM 8 12M 4
SUN TIME

Fig. A-1—Low temperature radiant energy emitted by outdoor surroundings

Consideration has been given to the effect of radiation exchange with outdoor surroundings. For design conditions it has been assumed that the sky is clear. The data for radiation from a clear sky have been based upon the work of Brunt[6], who has correlated the observations of Dines and Dines made in England over a period of several years. The low temperature radiant energy emitted by the clear sky toward a horizontal surface, R_{1h}, Btu per (hour) (square foot), is given by the following equation:

$$R_{1h} = R_{1b}\,(0.55 + 0.056\,\sqrt{M}\,) \text{ .. (A-2)}$$

It can be shown that the radiation from a clear sky that is received by a vertical surface, R_{1v}, Btu per (hr) (sq ft), is given by the following equation:

$$R_{1v} = R_{1b}\,(0.30 + 0.028\,\sqrt{M}\,) \text{ .. (A-3)}$$

where

R_{1b} = black body radiation at the temperature of the air, t, Fahrenheit degrees at ground level $= 0.173\left(\frac{t + 460}{100}\right)^4$.

M = vapor pressure, millibars, at ground level.

Observations made at the ASHVE Laboratory with a special radiometer show that, in the absence of solar radiation and with reasonable wind velocities, the ground itself radiates substantially as a black body radiating at air temperature. Since the angle factor of the ground with respect to a vertical plane is 0.5, the radiant energy contribution of ground and sky to vertical surfaces is

$$R_{1v} + 0.5\,R_{1b} \quad \text{.....(A-4)}$$

If the sky is overcast the entire outdoor surroundings radiate essentially as a black body at air temperature. Clouds are black body radiators and, if the overcast is low, the cloud base is little different in temperature from the air temperature at ground level.

Fig. A-1 illustrates typical measurements made at the ASHVE Laboratory of the radiant energy emitted by the surroundings to vertical and horizontal building surfaces. For example, data for February 28 and March 1, 1949 illustrate the fact that the outdoors with overcast sky radiates nearly as a black body at air temperature. The values for August 10, 1949 for energy received from a clear sky by a horizontal surface are within 10 percent of the values computed by Equation A-2 while the nighttime values shown for April 4, 1949 are in good agreement with Equation A-4.

The design surface conductance for convection only has been rather arbitrarily taken as 4.0 Btu per (hr) (sq ft) (F deg). This value corresponds to the average value for a smooth 10 ft long surface swept by a parallel non-turbulent air stream of 15 mph as determined by wind tunnel tests[11] made at the ASHVE Research Laboratory. When combined with radiation, the surface conductance is approximately 6.0, a figure which has been commonly used in heat loss calculations. It is important to note that the surface conductances for convection and radiation *combined* depend upon the thermal resistance of the glass. For example, for single glass it is 5.55 and for double glass with quarter inch air space it is 6.62 Btu per (hr) (sq ft) (F deg).

Outdoor Design Conditions: Sunlit Glass

An air temperature curve which has a maximum value of 95 F and a minimum of 74 F has been used as a basis for the convection and radiation gain tables for sunlit glass. This curve has been used in the tables of heat gain through walls and roofs published in Chapter 12 of THE 1950 GUIDE[18].

Radiation exchange between vertical surfaces and the outdoor surroundings by day is complicated by the fact that the sun heats the ground and nearby buildings. Numerous measurements, illustrated by Fig. A-1, have been made at the Laboratory and show some correlation with dewpoint. However, these data are insufficient to suggest design values. Therefore, convection and radiation heat transfer *have been combined* in an arbitrary value of 4.0 Btu per (hr) (sq ft) (F deg) for the outdoor surface conductance. As stated in the text, the principal virtue in using this value is that it is consistent with present practice in estimating heat gain through walls and roofs.

Solar Intensity Values

The solar data given in Tables 12 and 13 of the text have been derived from several sources. The values of direct solar radiation for clear atmospheres are the suggested values of Parry Moon[7]. These values are within 5 percent of the values derived from the suggested sol-air design data[8] for Lincoln, Neb. They have been used in preference to the latter because of their acceptance as a

standard and because the solar energy distribution is also standardized. The values for an industrial atmosphere were derived from suggested sol-air design temperatures[8] for New York City for a horizontal plane and absorptivity of 1.0. The solar component was found by subtracting from the sol-air temperature the dry bulb temperature which was not exceeded more than 5 percent of the time in a 10-year period in the summer months. This component multiplied by 4 gave the total solar intensity on a horizontal plane. These values were then divided into direct and diffuse components.

The diffuse solar radiation values were derived from an analysis of a considerable number of selected recordings of the daily cycle of total, direct, and diffuse radiation received on a horizontal plane at Cleveland. A family of curves was developed, each of which gave the ratio of direct to diffuse radiation on a horizontal plane as a function of solar altitude. The parameter for this family of curves was the value of the direct normal solar intensity at air mass 2 (solar altitude of 30 deg). Data were then analyzed to develop ratios of diffuse radiation on vertical planes to that on a horizontal plane. All values of diffuse radiation for vertical surfaces include an uncertain amount of ground reflection. Examination will show that they are influenced by the position of the sun.

APPENDIX B

Thermal Properties of Glass

Transmittance Data:
Flat Glass

The transmittance values for glasses A, B, C, and D and their various combinations are given in Table B-1 for use in calculating gain for other exposures and latitudes. The absorptance values are given in Table B-2. These were computed from the spectral transmittance data of four samples studied at the Laboratory for the solar energy distribution given by Moon[7] for an air mass of 2. The same energy distribution was used for all solar altitudes and for both clear and industrial atmospheres. This procedure is not exact but is believed to be a practical method of treating a very complex problem and one that is not subject to great error. As stated in the text, the fact that the absorptance increases as transmittance decreases causes the total gain to change only a little, although the distribution between gain due to transmitted solar energy and that due to convection and radiation from the indoor glass surface is altered.

These transmittance values will be found to agree with experimental data given in ASHVE RESEARCH REPORTS[1,2] within the limits of energy distribution effects. Transmittance data for diffuse solar radiation are based upon test results since there is no standard energy distribution for this component of solar radiation. It is known, and test results bear out the fact, that the energy on clear days is concentrated in the visible portion of the solar spectrum. Absorptances for diffuse solar radiation were calculated for the Moon[7] energy distribution for air mass of 2. Each value was then adjusted by the difference between the observed and the computed transmittances for diffuse solar radiation.

Transmittance Data:
Glass Block

The transmittance data for the block patterns listed in Table 2 were taken from test data given in an ASHVE RESEARCH REPORT[2] presented in 1949. Reference to the spectral transmittance values of samples taken from the block (see discussion of this paper) will show that differences in solar energy distribution will not greatly alter the transmittance values.

Air Space Conductances

The recent correlation by Jakob[10] of the data of Mull and Reiher has been used as the basis for convection heat transfer across air spaces of ½ in. or greater. The values are substantially lower than those of other investigators, possibly, as Jakob suggests, due to the absence of edge heat transfer. However, when radiation exchange between parallel glass plates is included, the differences between the values used in preparing these tables and those of THE GUIDE are not great.

Thermal Conductivity

The thermal conductivity of glass has been taken as 6.0 Btu per (hr) (sq ft) (F deg per in.). Glass thickness has been taken as ⅛ in. (double strength glass). However, the thermal resistance of the glass is so low that the values may be used for other thicknesses with but little error. In computing the heat gain through sunlit flat glass the thermal resistance of the glass sheet has been neglected.

Conductances of Glass Block Panels

These data have been taken directly from Table 5, page 5 of an ASHVE RESEARCH REPORT[4]. There is some evidence that these values vary with surface conductance but there are not enough data from which to draw conclusions regarding the variation.

APPENDIX C

Computation Methods

Overall Coefficients

For the steady state, the heat flow through a sheet of glass in the absence of solar radiation is given by the expression:

$$q = h_i (t_i - t_{gi}) = \frac{k}{L} (t_{gi} - t_{go}) = h_o (t_{go} - t_o) + R_s \quad \ldots\ldots\ldots (C\text{-}1)$$

where

q = rate of heat flow, Btu per (hour) (square foot).

h_i = the indoor surface conductance for radiation and convection combined, Btu per (hour) (square foot) (Fahrenheit degree).

h_o = the outdoor surface conductance for convection, Btu per (hour) (square foot) (Fahrenheit degree).

Table B-1—Fraction of Incident Solar Radiation Transmitted by Flat Glass

Glass	Single Sheets				Two Sheets			
	A	B	C	D	A+A	B+B	B+C[a]	C+C
Incident Angle	For Direct Solar Radiation							
0	0.90	0.77	0.41	0.21	0.81	0.60	0.35	0.24
20	0.90	0.77	0.41	0.21	0.81	0.60	0.35	0.24
40	0.89	0.75	0.39	0.20	0.80	0.58	0.33	0.22
50	0.87	0.72	0.37	0.19	0.77	0.55	0.32	0.20
60	0.82	0.67	0.33	0.17	0.71	0.50	0.28	0.18
70	0.70	0.57	0.28	0.13	0.59	0.39	0.21	0.13
80	0.44	0.36	0.18	0.08	0.29	0.18	0.10	0.05
90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	For Diffuse Solar Radiation							
	0.82	0.69	0.40	0.22	0.72	0.56	0.32	0.25

[a]Sheet C is outdoor sheet.

Table B-2—Fraction of Incident Solar Radiation Absorbed by Flat Glass

Glass	Single Sheets				Two Sheets[a]			
	A	B	C	D	A+A	B+B	B+C[b]	C+C
Incident Angle	For Direct Solar Radiation							
0	0.02	0.16	0.53	0.74	0.02-0.02	0.17-0.10	0.54-0.04	0.54-0.15
40	0.02	0.17	0.55	0.75	0.02-0.02	0.18-0.11	0.55-0.04	0.56-0.15
60	0.02	0.19	0.56	0.74	0.02-0.02	0.20-0.12	0.58-0.04	0.57-0.13
75	0.02	0.18	0.49	0.62	0.02-0.02	0.21-0.10	0.53-0.03	0.51-0.09
90	0.0	0.0	0.0	0.0	0.0 -0.0	0.0 -0.0	0.0 -0.0	0.0 -0.0
	For Diffuse Solar Radiation							
	0.02	0.16	0.50	0.68	0.02-0.02	0.17-0.09	0.53-0.04	0.51-0.11

[a]First value for outdoor sheet, second value for indoor sheet.
[b]Sheet C is outdoor sheet.

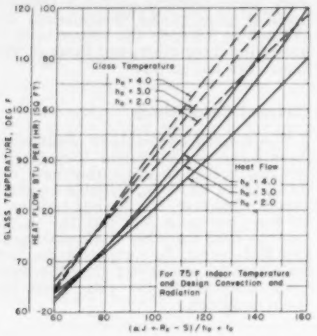
Glass Temperature
h_o = 4.0
h_o = 3.0
h_o = 2.0
Heat Flow
h_o = 4.0
h_o = 3.0
h_o = 2.0
For 75 F Indoor Temperature and Design Convection and Radiation
GLASS TEMPERATURE, DEG F
HEAT FLOW, BTU PER (HR) (SQ FT)
$(a_1 J + R_x - S_1)/h_o + t_o$

Fig. C-1—Convection and radiation heat gain and temperature for single glass

k = thermal conductivity of glass, Btu per (hour) (square foot) (Fahrenheit degree per foot).

L = glass thickness, feet.

t_i = indoor temperature, Fahrenheit degrees.

t_o = outdoor air temperature, Fahrenheit degrees.

t_{g1} = temperature of indoor surface of glass, Fahrenheit degrees.

t_{g2} = temperature of outdoor surface of glass, Fahrenheit degrees.

R_x = net radiant energy exchange between glass and outdoor surroundings, Btu per (hour) (square foot).

For glass block walls and double glass, $C(t_{g1} - t_{g2})$ was used in place of $k/L\ (t_{g1} - t_{g2})$, where C is the conductance of the section, Btu per (hour) (square foot) (Fahrenheit degree). Because of the dependence of h_i and R_x on t_{g1} and t_{g2}, Equation C-1 requires a trial and error solution. In this instance a curve plotting method was used.

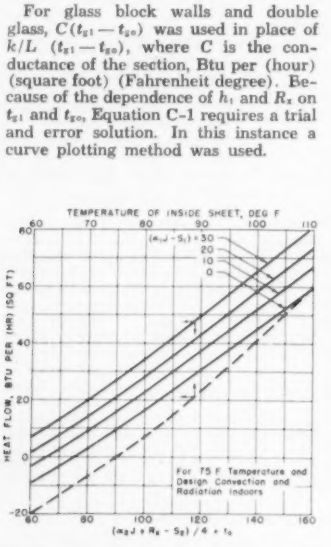
TEMPERATURE OF INSIDE SHEET, DEG F
$(a_1 J - S_1) = 30$
20
10
0
For 75 F Temperature and Design Convection and Radiation Indoors
HEAT FLOW, BTU PER (HR) (SQ FT)
$(a_2 J + R_x - S_2)/4 + t_o$

Fig. C-2—Convection and radiation gain and temperature of indoor sheet for double glass

Convection and Radiation Gain from Sunlit Flat Glass

The computation of convection and radiation gain from sunlit glass is more complex so that it was necessary to simplify the heat balance equations by ignoring the small influence of the thermal resistance of the glass sheet. Equation C-1, now including terms for solar energy absorption and heat storage becomes:

For one sheet:

$$q = h_i\,(t_{g1} - t_i) = a_1 J + R_x - S_1 - h_o\,(t_{g1} - t_o) \quad \text{.....(C-2)}$$

For two air-spaced sheets:

$$q = h_i\,(t_{g1} - t_i) = a_1 J - h_o\,(t_{g1} - t_{g2}) - S_1 \quad \text{.....(C-3)}$$

where

t_{g1} = temperature of a single sheet (or of the indoor of two sheets), Fahrenheit degrees.

t_{g2} = temperature of the outdoor glass sheet, Fahrenheit degrees.

a_1 = fraction of the incident radiation absorbed by a single sheet (or by the indoor of two sheets).

J = incident solar radiation, Btu per (hour) (square foot).

S_1 = rate of heat storage of a single sheet (or of the indoor of two sheets), Btu per (hour) (square foot).

h_s = air space conductance, Btu per (hour) (square foot) (Fahrenheit degree).

These heat balances must also be solved by trial and error. For a fixed indoor temperature, however, curve families with h_o as the parameter can be drawn with heat flow and t_{g1} as functions of the expression $\frac{a_1 J + R_x - S_1}{h_o}$.

Since R_x and h_i are dependent upon t_{g1} and t_{g2}, a trial and error solution is required. Fig. C-1 shows curves for a single sheet of glass for an indoor temperature of 75 F, the design indoor convection equation and several values of h_o. Fig. C-2 presents a set of curves for two glass sheets for the same conditions with h_o fixed at 4.0 Btu per (hr) (sq ft) (F deg). The curve parameter is the amount of solar radiation absorbed by the indoor sheet of glass. The subscript 2 on a and S refers to the outdoor sheet. A net work chart has been constructed to express Equations C-1 and C-2 in general terms.

In setting up Tables 5 and 7, no attempt has been made to treat R_x because of the inadequacies of the present data. Instead a surface conductance of 4.0 Btu per (hr) (sq ft) (F deg) has been used to approximate the combined results of convection and radiation. The rate of heat storage, S_1, has been taken into account by adding algebraically to the computed heat gain the rate of heat storage as determined experimentally. This quantity is insignificant for glass A but of appreciable magnitude for the heat absorbing glasses.

Convection and Radiation Gain from Sunlit Glass Block

Of several attempts to devise a rational method of determining periodic heat flow through glass block walls by use of either basic thermal properties or test data, or both, only one was reasonably successful. This method, used in computing the values in Tables 9 and 11, required a series of heat balances, in which the radiation absorbed by the block in a one-hour period was balanced against the stored energy and the heat lost at the indoor and outdoor surfaces in the same period. A trial and error solution gave the temperature of the indoor surface of the glass at the end of the period. This temperature was then the starting point for the next period. Necessary to the computations was a relationship between the indoor and outdoor air temperature difference, and the indoor and outdoor glass block surface temperature difference. Empirical curves which gave this relationship as a function of sun time were developed for each orientation from fixed position tests made on the various panels. Absorption coefficients for the blocks were computed from test data by means of heat balances. It was found that the six patterns could be placed in three groups as shown in the design tables.

Although the separate influence of such variables as wind, solar intensity and radiation exchange could not be entirely accounted for in fairing the empirical temperature difference curves, nevertheless the computed design data showed satisfactory correlation with experimental measurements in those tests in which design conditions were closely approximated. Computation was simplified when it was found that the heat flow from the indoor surface for a fixed indoor temperature and heat capacity was a linear function of a three-term sum which involved the absorbed solar radiation, the surface temperature difference, and the outdoor air temperature and surface conductance.

In concluding this discussion of computation methods, some comments on the effect of ignoring radiation exchange with the outdoor surroundings are appropriate. In general, it may be said that, whenever summer temperatures prevail and a wall is not irradiated by the direct sun, its outdoor surface temperature usually indicates that it is gaining heat by convection from the air. However, it will often be found that it is losing heat at a considerably greater rate by radiation to the sky and ground. Hence the design values of heat gain by convection and radiation for flat glass are somewhat higher for those periods when they are not directly exposed to the sun than would be the case if radiation exchange had been included.

On the other hand the temperature difference curves for the glass block are to some degree affected by radiation exchange. Therefore, the values for convection and radiation gain from flat glass and glass block are not strictly comparable. At the time of peak heat gain the loss by radiation is less in proportion to that by convection, so that the use of a design surface conductance of 4.0 Btu per (hr) (sq ft) (F deg) approximates fairly well the combined effect of a low wind velocity and radiation exchange.

PROGRAM SEMI-ANNUAL MEETING - 1950

Royal Muskoka Hotel, Ontario, Canada

(Eastern Daylight Saving Time)

Saturday, June 17

11:00 a.m. Committee on Research, R. C. Cross, *Chairman* (Royal York Hotel, Toronto)

Sunday, June 18

2:00 p.m. REGISTRATION

3:30 p.m. Council Meeting

4:00 p.m. Ladies Tea
(Evening free for Hotel Concert and Movies)

Monday, June 19

9:00 a.m. REGISTRATION

9:30 a.m. TECHNICAL SESSION

Welcome Address

Response by Pres. Lester T. Avery

Transient Heat Flow Apparatus for the Determination of Thermal Conductivity, by F. C. Hooper and F. R. Lepper

Balancing a Steam Heating System by the Use of Orifices, by D. E. Schroeder

Plant Research in the Phytotron, by Arthur J. Hess

*Thermal Conductivity of Soils for Design of Heat Pump Installations, by G. S. Smith and Thomas Yamauchi

11:00 a.m. Boat Trip for Ladies (box lunches—return by 3:00 p.m.)

12:30 p.m. Welcome Luncheon
Speaker—E. Holt Gurney, Past President of ASHVE

1:30 p.m. Golf Tournament for Research Cup and Eichberg Memorial Trophy

2:00 p.m. TAC on Cooling Load

2:00 p.m. TAC on Weather Design Conditions

2:00 p.m. Shuffleboard, Archery, Bowling, Tennis, Horseshoe Pitching, etc.

9:00 p.m. Muskoka Frolic—Get-together (Square Dancing, Weiner Roast, Beach Party)

*To be presented by title

Tuesday, June 20

9:00 a.m. REGISTRATION

9:30 a.m. TECHNICAL SESSION

Heat Flow Through Unshaded Glass, by G. V. Parmelee and W. W. Aubele

Effective Solar Absorption of Various Colored Paints, by R. H. Heilman and R. W. Ortmiller

A Proposed Psychrometric Chart, by H. B. Nottage

*A Simple Heated-Thermocouple Anemometer, by H. B. Nottage

11:00 a.m. Boat Trip (box lunches); also Fast Motor Boat Trip Around Islands (both return by 5:00 p.m.)

2:00 p.m. Nominating Committee—R. T. Kern, *Chairman*

2:00 p.m. Guide Committee

2:00 p.m. Informal Golf for Ladies and Gentlemen

7:00 p.m. BANQUET

Toastmaster—H. D. Henion

Speaker—John A. Marsh, M.B.E.
Subject—This Canada of Ours

Musical Entertainment and Dancing
(Formal or Informal Dress Optional)

Wednesday, June 21

9:30 a.m. REGISTRATION

10:00 a.m. TECHNICAL SESSION

Effect of Temperature on Balance of Forced Warm Air Systems, by N. A. Buckley, S. Konzo, J. M. David and T. L. Towne

Comparative Study of Ventilating Jets from Various Types of Outlets, by Alfred Koestel, Philip Hermann and G. L. Tuve

Energy Losses in 90-Degree Duct Elbows, by D. W. Locklin

Unfinished Business

New Business

Resolutions

Adjournment

Method of Choosing Location of, Financing and Conducting Meetings of the Society

Resolved: That inasmuch as the Annual and Semi-Annual Meetings of the Society come under the jurisdiction of the Council, the following rules governing the handling of such meetings be adopted by the Council and published in the JOURNAL of the Society at least twice during every year, preferably just prior to each meeting.

1—The Council will select the city in which the Annual or Semi-Annual Meeting is to be held, giving due consideration to the invitations received from Chapters or members as well as to the advisability of so distributing those meetings as to make them of the greatest advantage to the general membership, and to reduce as far as possible the expense of members attending.

2—That an appropriation be made to cover the entertainment or local expenses, incurred in connection with the meeting, and the regular meeting expense to be taken care of by the General Fund of the Society in the regular way.

3—That no registration fee or compulsory obligations of any nature be imposed on members or guests.

4—That the purchase of tickets for banquets or for any other form of entertainment that may be provided be entirely voluntary.

5—That the grouping of features and the sale of tickets for group features be discouraged.

6—That the raising of funds from manufacturers of heating apparatus be discouraged.

7—That the display of samples, or of literature, advertising the product of any manufacturer in any way, shape or form, be not permitted at the booths, registration desk, or in or about the meetings.

8—That the distribution of trade papers be entirely at the discretion of the committee in charge.

9—That the local Chapter or local members be empowered to form a General Committee with such sub-committees as may be required to handle the details of transportation, hotel accommodations, entertainment, finance, etc., and that this General Committee be requested to confer frequently with the Council, through the Secretary of the Society, and to make frequent reports on progress in connection with the various matters being handled by them.

10—That the arrangements of elaborate and costly entertainment features be discouraged.

Adopted at Council Meeting, January 29, 1926.

PERSONALS

W. H. Evans—Appointment of W. H. Evans as vice president and director of Minneapolis-Honeywell Regulator Co., Ltd., Leaside, Ontario, Canada, has been announced by H. W. Sweatt, president of the company.

Mr. Evans is a member of the Ontario Chapter of the ASHVE, and the *Toronto Board of Trade*, the *Stoker Institute of Canada*, the *National Warm Air Heating and Air Conditioning Association* and the Toronto executive committee of the *Canadian Manufacturers Association*.

P. A. Formel—Mr. Formel has been assigned as sales representative of the National Radiator Co., Johnstown, Pa., and will handle the sale of the company's heating equipment and accessories in the New York area. Mr. Formel is a member of the ASHVE.

James C. Matchett—At the annual meeting of the Board of Directors of Illinois Engineering Co., Chicago, James C. Matchett, a member of the ASHVE since 1923, was elected president and treasurer. Mr. Matchett, also a member of *ASME*, is well known in the industry having joined the Company in 1912. He has served as vice president and general manager for 27 years.

James C. Matchett
Chicago, Ill.

The Company, now celebrating its 50th year, also announced the election of Gordon L. Harris as vice president and assistant treasurer, and L. B. Carlson as secretary. Robert L. Gifford, who has served as president and treasurer of the Company since its incorporation in 1900, is now chairman of the Board.

Lorin G. Miller—Dean of the College of Engineering at Michigan State College, has been appointed engineering consultant by United States Radiator Corp., it was announced by W. J. Peoples, chairman of the board and president of the corporation.

Lorin G. Miller
East Lansing, Mich.

Dean Miller is well known for his work in the field of heating for human comfort. He is active in the program of the *Institute of Boiler and Radiator Manufacturers*, and is responsible for a large part of the success of the training programs in the various branches of the heating industry.

In his new connection, Dean Miller will actively participate in engineering research and development of United States Radiator Corp. products.

Since joining the Society in 1933, Dean Miller has taken an active interest in the affairs of the Western Michigan Chapter, serving as its vice president and president. He has also served as a member of the Society's Council, and on various research Technical Advisory Committees.

Besides being a member of the ASHVE, he is also a member of the *ASME* and the Lansing Engineers Club.

Clark T. Morse, Life Member of ASHVE, president of American Blower Corp. and a member of the American-Standard board of directors, has been appointed to the executive committee of the American Radiator & Standard Sanitary Corp., as announced by T. E. Mueller, president of the corporation. Mr. Morse is also a member of *ASME*.

E. M. Palmer has been elected vice president of Kewanee Boiler Corp. according to an announcement by the Board of Directors. This promotion, it is felt, will be a source of gratification to his numerous friends in the heating profession. Besides being an associate member of ASHVE, he is a director of the *Steel Boiler Institute*.

W. B. Russell—At a meeting of the Board of Directors of Kewanee Boiler Corp., held recently in New York, N.Y., it was announced that W. B. Russell was elected president of Kewanee Boiler Corp. to fill the vacancy created by the death of R. B. Dickson. Mr. Russell was also elected a director of the company.

Joining Kewanee Boiler Corp. July 1, 1933, as a time study engineer, Mr. Russell was moved into the sales department in 1934, and on March 24, 1938, was advanced to assistant to the president. On February 5, 1945, he was elected vice president of Kewanee Boiler Corp.

F. PAUL ANDERSON AWARD

The Committee of Award for the F. Paul Anderson Medal invites the members of the ASHVE to nominate members of the Society whose notable scientific achievement or outstanding services performed in the field of heating, ventilating or air conditioning should receive recognition.

The Committee should receive nominations with a statement of the candidates' achievements prior to August 1, 1950.

Lauren E. Seeley, *Chairman*
F. Paul Anderson Committee

Summary of Chapter Meetings*

• ATLANTA—April 10, 1950. The members and guests of the Atlanta Chapter met at Harris' Tea Room where Pres. W. M. Garrard called the business meeting to order. Reports were submitted by the various committee chairmen. Gene O'Brien introduced the speaker of the evening, L. E. Seeley, first vice president of the Society and Dean of the College of Technology, University of New Hampshire, Durham, N. H., who spoke on *The Importance of Relative Humidity as It Relates to People.* Dean Seeley presented a detailed, illustrated story on his experimentation with air temperatures and humidities in the nasal cavity, the controlling mechanisms employed by nature in this connection and the apparent relationship between the humidity of the air we breathe and comfort. After a brief discussion with questions from the floor, the meeting was declared adjourned at 9:25 p.m. Attendance 42.

• BALTIMORE—April 19, 1950. The regular monthly meeting was held at the Engineer's Club and before introducing the speaker of the evening, A. M. Norris, chairman of the nominating committee, gave a report of his committee, and it was announced that the election of the nominees given would be held at the next meeting. C. F. Neergaard, hospital consultant, Neergaard and Craig, New York, N. Y., then delivered an interesting talk on the problem of economically heating, ventilating and air conditioning hospitals. A lengthy discussion period followed. Attendance 44. Attendance ratio 0.53.

• CENTRAL OHIO—March 20, 1950. Pres. E. A. Norman, Jr., presided at the March meeting held at the Grandview Inn. A. D. Bogen, submitted his report as treasurer and President Norman announced the appointment of the nominating committee as follows: R. B. Jackson, W. M. Myler, Jr., and R. A. Sherman.

Professor Carruthers, head of the ceramic engineering department of Ohio State University, guest speaker of the evening, spoke on the field of ceramics. His talk covered the history of ceramics and the scope of the industry as to the value, people occupied, power required, and general scope. Professor Carruthers also discussed various types of material used in ceramics, temperatures involved, chemical analyses, and some representative materials in which the ceramic industry is interested. Following a short question and answer period, the meeting adjourned at 10:15 p.m. Attendance 24. Attendance ratio 0.21.

• CINCINNATI—April 3, 1950. Pres. K. B. Little called the meeting to order at the Engineering Society Headquarters and the minutes of the March meeting were read and approved. President Little appointed R. C. Beineke, chairman; J. G. Blanchard, and R. J. Hanschen to serve as the auditing committee. H. E. Sproull, a member of the Society's Council, reported on the meeting in Dayton and announced that C. D. Weaver, Jr. had been elected temporary chairman of the newly formed group in Dayton. E. W. McNamee reported that President Little had been elected secretary-treasurer of the Technical and Scientific Council of Cincinnati, an honor for the Cincinnati Chapter and the Society.

The remainder of the meeting was devoted to a panel discussion on the *Present Heating and Ventilating Industry* and the panel members consisted of: R. J. Hanschen, moderator; O. W. Motz, consulting engineer; A. W. Edwards, sales engineer; J. J. Bechtol, heating and ventilating contractor. The panel was conducted very capably by Mr. Hanschen and the discussion was limited to the panel members with some time alloted to discussion from the floor. The following are the questions with the general opinions:

1. *What should we do to have a greater membership attendance at our meetings?*

Have more local talent for our meetings. Have more topics of interest to engineers. More local discussion and participation from our consulting engineers. Local technical committees to be established to assist in presenting valuable data through the meetings committee.

2. *How should we participate in establishing "minimum requirements of design and codes?*

It was agreed that the Cincinnati Chapter members, as engineers, should feel a responsibility in developing good workable design codes locally. National codes and requirements will be handled on a broad scale through the Society.

Considerable discussion of various phases of local requirements ensued and many unfair and impracticable limitations in local codes were enumerated.

3. *What are the advantages and disadvantages of central station air conditioning vs. unit type systems?*

Broad discussion followed and the various circumstances warranting both types of systems were enumerated. It was generally agreed that each job must be analyzed carefully as either system may be most suitable depending upon many varied conditions which may exist.

4. *How should electrical work be handled in specifications?*

The consensus was that wherever possible, all electrical work should be segregated under an electrical section of the specifications. It was agreed, however, that under special circumstances it would be advisable to include electrical work under other sections where specialized handling was required.

Attendance 48. Attendance ratio 0.39.

• CONNECTICUT—April 20, 1950. The Connecticut Chapter's annual meeting was held at the Waverly Inn in Cheshire, Conn., with Pres. Winfield Roeder presiding. He appointed the tellers of election, R. J. Lorenzi, R. B. Sweet, and L. A.

*Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

Teasdale, who reported the results as follows: *President*—D. M. Hummel; *Vice President*—A. J. Lawless; *Secretary*—G. F. Nieske; *Treasurer*—T. L. Arnold; *Board of Governors*—Mr. Roeder, R. W. Sidbury, and J. R. Smak.

President Roeder then presented the gavel to the incoming president and Mr. Teasdale presented the past president's pin to retiring President Roeder.

Since no outside speaker had been scheduled for this meeting, there was a round table discussion headed by Mr. Lawless on the contact between the engineers and the contractors on the specification and actual installation of materials specified for jobs. Mr. Lawless was most emphatic in his belief that contractors must supply the materials specified by the engineers to protect the owner. The meeting adjourned at 10:00 p.m. Attendance 37. Attendance ratio 0.24.

• **DELTA**—April 11, 1950. Members of the Delta Chapter met in the Trophy Room of the New Orleans Athletic Club where Pres. R. B. Guest called the meeting to order. G. E. May, chairman of the nominating committee, announced the committee's recommendations for the 1950-51 season and the results will be announced at the annual meeting. J. S. Burke then introduced the speaker of the evening, Dean L. E. Seeley, College of Technology, University of New Hampshire, Durham, N. H., who spoke on *Is Humidity Control Important for the Air We Breathe?* Dean Seeley's talk was thoroughly enjoyed by the members and after a vote of thanks was extended to him, the meeting was adjourned. Attendance 27. Attendance ratio 0.30.

• **GOLDEN GATE**—April 6, 1950. The April meeting was devoted to the showing of a motion picture of the development and application of the varidrive entitled, *Rhapsody in Speed*. The picture was shown by W. A. Joubert through the courtesy of the U. S. Electrical Motors, Inc. The meeting adjourned at 8:50 p.m. Attendance 49.

• **GOLDEN GATE**—March 2, 1950. Pres. K. F. Baldwin opened the meeting and announced the appointment of F. W. Kolb as chairman of the constitution and by-laws committee and C. H. Bazille as chairman of the legislative committee. V. Dale Wissmiller, sales supervisor, Minneapolis-Honeywell Regulator Co., Minneapolis, gave an illustrated talk on the evolution of Railway car heating and air conditioning and the application of electronic controls to air conditioning in recently built cars. An interesting color motion picture demonstrated the recent development in anemostat air diffusers. Attendance 51.

• **ILLINOIS**—April 10, 1950. President J. S. Kearney opened the meeting and announced the appointment of Messrs. C. S. Becker, J. H. Milliken, and E. R. Teske, to serve as the auditing committee. President Kearney also announced the recent death of R. B. Dickson, president of Kewanee Boiler Corporation and a Life Member of the Society. At the conclusion of the Chapter business, H. A. Lockhart, chairman of the meeting, introduced J. K. Fairbairn, whose subject was *High Temperature Water Heating Systems*. He outlined the history of hot water heating and referred to many large water systems such as Montgomery Ward, Chicago, Ohio State University Campus Buildings, and further explained the increase in accepted temperatures through the past years and pointed out the flexibility of such systems. He further discussed some of the problems involved in hot water heating systems, such as, vapor lock, air vent problems, etc., and explained his success in the use of lye in hot water heating systems when hydrogen caused serious venting problems.

Mr. Fairbairn covered the basic design of hot water heating such as direct return, reverse return, and one pipe systems and various combinations of them all. He concluded his talk with reference to systems designed in the history of hot water s.ill in use in Switzerland operating at 300 deg. Considerable discussion followed Mr. Fairbairn's talk and it was evident from the lengthy discussion that a keen interest was shown in the speaker and his subject. Attendance 143. Attendance ratio 0.25.

• **ILLINOIS**—March 13, 1950. Following the formal opening, by President Kearney, the meeting, which was devoted to the subject of *Industrial Ventilation*, was turned over to C. M. Barnes, chairman of the meeting.

Mr. Barnes first introduced E. E. Sundeen, supervisor of air conditioning, International Harvester Co., Chicago, who explained in detail the ventilation problems at the company's plant at Memphis, Tenn. He pointed out that throughout this plant the recommendations of the *American Foundrymen's Association* were followed. In discussing this particular problem, he mentioned that 4,485,000 cu ft of air is exhausted each seven minutes. He explained that the building has a total of 100 separate exhaust systems which do this job. He further pointed out that the exhaust air is constantly replaced by the use of 16 outside-air heaters, uniformly spaced through the building.

W. N. Witheridge, ventilation consultant for the General Motors Corp., Detroit, was the second speaker of the evening. Mr. Witheridge pointed out the importance of considering outside air conditions in relation to general ventilating problems inside the plant. He explained that in some cases exhaust air may offer a greater pollution problem than plant ventilation in itself and pointed out that it is necessary to purify outdoor air before it is introduced into the plant.

Slides were used to illustrate both talks which resulted in explicit and complete handling of the subjects.

Attendance 145. Attendance ratio 0.27.

• **IOWA**—April 11, 1950. The April meeting was held at the Elks Club in Des Moines with Pres. D. E. Wells presiding. Following dinner, the business meeting was called to order by President Wells and the reading of the minutes of the previous meeting was dispensed with. The nominating committee appointed at the March meeting submitted their report. Raymond Mancha, vice president, Joy Manufacturing Co., showed a colored movie of the various tests and manufacturing steps used in the manufacture of vaneaxial fans. Following the movie Mr. Mancha gave an interesting discussion on the application of vaneaxial fans discussing fields where they were very well adapted and also pointing out the limitations of them. From the report of the secretary, the meeting proved interesting to the audience. Attendance 42.

• **IOWA**—March 21, 1950. The March meeting was held at the Memorial Union Building, Iowa State College, Ames. President Wells appointed B. E. Landes, D. C. Murphy, and C. A. Wheeler to serve on the nominating committee. All other business was dispensed with and Vice Pres. R. S. Stover introduced Cyril Tasker, director of research, ASHVE Research Laboratory, Cleveland, as the guest speaker. In his opening remarks, Mr. Tasker brought out the fact that the Society is the only engineering society which carries on a research program. He then spoke on the *What and Why of ASHVE Research*. He gave an interesting discussion of the work being carried on at the Laboratory in Cleveland and also by the various colleges that are cooperating. The meeting adjourned at 8:30 p.m. Attendance 48.

• **KANSAS CITY**—April 3, 1950. Pres. Henry Nottberg, Jr. called the meeting to order in the Aladdin Hotel Roof Garden. W. K. Dyer, chairman of the Student Branch Committee, was requested by President Nottberg to act as graduate student employment coordinator. An interesting lecture and discussion was given on the *Latest Developments in Solar Heating and Its Controls* by J. E. Haines, vice president of Minneapolis-Honeywell Regulator Co. and a member of the Society's Council, Minneapolis, Minn. Mr. Haines' talk was interesting and instructive and following a discussion the meeting adjourned. Attendance 75.

• **KANSAS CITY**—March 6, 1950. Pres. Henry Nottberg, Jr. presided at the meeting held in the Aladdin Hotel Roof Garden. The minutes of the February meeting were read and approved. H. H. Lewis reported as chairman of the membership committee and J. L. Williams, president of the University of Kansas Student Branch, announced the forthcoming Engineering Exposition. D. M. Allen, member of the Society's Council, announced that a Student Branch was being formed at the Oklahoma A & M College, Stillwater, and that he was planning to attend the charter meeting.

The speaker of the evening, A. B. Newton, Acme Industries, Inc., Jackson, Mich., gave a most interesting talk and discussion on *Refrigeration Heat Transfer Units*. Following the discussion, the meeting adjourned. Attendance 104.

• **MANITOBA**—March 16, 1950. A. W. Moss, president, called the meeting to order at the Fort Garry Hotel. The nominating committee was appointed, consisting of P. L. Charles, Lloyd Finch, R. L. Kent, W. H. McKay and J. R. Stephenson. The committee was instructed to present the slate of officers at the next meeting.

Due to unfortunate grounding of his plane at Fargo, North Dakota, Prof. R. C. Jordan wired that he would be unable to attend the meeting. Under the circumstances, the meeting adjourned to Salon "C" where a program of entertainment was thoroughly enjoyed. The meeting was adjourned at 9:45 p.m. Attendance 31. Attendance ratio 0.38.

• **MASSACHUSETTS**—April 18, 1950. Pres. W. H. Shipp called the meeting to order in the Campus Room of M.I.T. and it was announced that the following were elected for the coming year: *President*—D. W. Blair; *Vice President*—John Bonner; *Secretary*—W. A. Williams; *Treasurer*—G. B. Torrens; *Board of Governors*—L. R. Geissenhainer, D. C. Miller, and F. A. Merrill. The meeting was then turned into a forum and the following members of the Massachusetts Chapter spoke: A. L. Hesselschwerdt, Jr., professor of mechanical engineering, M.I.T., chose as his subject, *Teaching and Research;* E. L. Blair, chief building service engineer, Stone & Webster Engineering Corp., spoke on *Consulting Engineering;* J. W. Brinton, district manager, American Blower Corp., gave his version of *Sales Engineering;* E. A. Dusossoit, president and treasurer, Lynch and Woodward, Inc., concluded the talks by devoting his remarks to *Contracting*.

This forum of speakers discussed the opportunities and prospects for students and trainees in the heating and ventilating field. After the regular discussion period, the meeting adjourned at 9:45 p.m. Attendance 60. Attendance ratio 0.24.

• **MICHIGAN**—April 17, 1950. The regular monthly meeting of the Michigan Chapter was held at the H. A. Rackham Memorial Building, Detroit. Pres. L. A. Burch called the meeting to order and the minutes of the previous meeting were read and approved. E. F. Glanz, chairman of the membership committee, in his report for the year, announced that there were now 201 members on the Chapter roll. E. F. Hyde reported on the Student Branch activities of the University of Detroit and stated that they were an ambitious group and were planning another big meeting be-

fore the season ends. This meeting is planned as a panel discussion on *Opportunities for the Young Engineer.*

Vice Pres. C. F. Donohoe introduced J. E. Haines, vice president, Minneapolis - Honeywell Regulator Co., Minneapolis, and a member of the Society's Council, who gave an interesting talk on the subject *Solar Radiation.* His subject was well received as was exemplified by the number of questions in the discussion that followed. The meeting adjourned at 10:00 p.m. Attendance 62. Attendance ratio 0.39.

• **MINNESOTA**—March 6, 1950. Members met at the Curtis Hotel and Pres. R. C. Jordan opened the meeting. The nominating committee members were then appointed as follows: R. O. Anderson, C. P. Petersen, P. D. Robinson, J. F. Stafford, and E. J. Uhl.

D. A. Campbell, manager, Industrial Division, Bryant Heater Co., Cleveland, was introduced by President Jordan and gave an excellent talk on the wide varieties of gas fuels and their combustion characteristics. He provided copies of engineering data on rate of flame travel with different gaseous fuels and explained the need for varying types and sizes of combustion chambers to meet these characteristics. He then illustrated by slides the development of a typical burner, and showed various combinations of equipment and devices used for control and safety purposes. His talk brought forth numerous questions from the members. The meeting adjourned at 9:15 p.m. Attendance 127. Attendance ratio 0.42.

• **MONTREAL**—March 13, 1950. Pres. S. W. Salter presided at the meeting held at the Berkeley Hotel. The officers elected for the coming year were announced as follows: *President*—R. R. Noyes; *Vice President*—J. G. Chenevert; *Secretary*—T. G. Anglin; *Treasurer*—B. J. Horsburgh; *Board of Governors*—W. G. Hole, R. S. Libby, D. L. Lindsay, S. R. Plamondon, and S. W. Salter.

The meeting was then turned over to the incoming President Noyes. The speaker of the evening, H. A. Lockhart, chief engineer, Bell & Gossett, Morton Grove, gave a talk on *Forced Hot Water Heating Systems.* The meeting adjourned at 10:15 p.m. Attendance 57.

• **NEBRASKA**—April 11, 1950. The regular monthly meeting of the Nebraska Chapter was held at the Hotel Castle, Omaha, with Pres. C. A. Carter presiding. The guest speaker of the evening was C. M. toe Laer, application engineer, General Electric Co., Bloomfield, N. J. He addressed the meeting on the subject of *High Pressure Warm Air* and discussed the outside wall registers and pointed out the various merits. The talk was extremely interesting and brought forth considerable discussion. Mr. toe Laer used numerous slides to illustrate the various installations demonstrated. The meeting adjourned at 9:00 p.m. Attendance 34. Attendance ratio 0.24.

• **NEBRASKA**—March 14, 1950. William Shirley, director of heating sales, Chrysler Airtemp, division of Chrysler Corp., spoke on *Heating Business Yesterday, Today, and Tomorrow.* Mr. Shirley traced the warm air heating system from 1949 to date, including the old floor furnace and the advent of forced warm air heating in 1929. He also discussed constant *vs.* intermittent blower operation, and variable gas flames from 10 to 100 percent of capacity. He referred also to the possibility of solar heating in the warmer states. A lengthy discussion period followed in which most of the members participated. Mr. Shirley's talk was well received and according to Secretary K. E. Martin's report the Nebraska Chapter members highly recommend Mr. Shirley's talk. Attendance 35. Attendance ratio 0.32.

• **NEW YORK**—April 17, 1950. The annual meeting was held in the Building Trades Club, New York, N. Y., and the meeting was called to order by Pres. H. S. Johnson. President Johnson welcomed C. Rollins Gardner of the North Texas Chapter, Dallas, and W. L. Fleisher, past president of the Society. The guest speaker of the evening, Lester T. Avery, president of the Society and president of Avery Engineering Co., Cleveland, before delivering his talk was called upon to present Life Membership certificates to L. K. Berman, William McClintock, O. O. Oaks, and J. O. Ross. C. R. Hiers, chairman of the board of tellers, reported the election of officers: *President*—Carl F. Kayan; *Vice President*—Ernst Graber; *Secretary*—Carl H. Flink; *Treasurer*—W. M. Heebner; *Board of Governors*—A. A. Giannini, P. B. Gordon, H. S. Johnson, J. E. Schechter, and R. L. Stinard.

Mr. Avery then delivered an interesting talk on *Dynamic Air Conditioning.* He discussed the various phases of air conditioning for comfort and industrial purposes. He used slides to illustrate his talk and in many cases, pointed out that while the air conditioning system had been necessary to obtain proper quality of product, it also provided optimum conditions for the occupants. Mr. Avery also stated that the members of the Society, which had done so much basic research in determining the physiological principles of air conditioning, should be ready to point out the advantages as well as the necessity of providing proper atmospheric environment. Mr. Avery's talk was followed by a question and answer period, after which a rising vote of thanks was given for the very worthwhile and interesting presentation. The meeting adjourned at 10:00 p.m. Attendance 75.

• **NEW YORK**—March 20, 1950. The regular monthly meeting was called to order by President Johnson who announced the appointment of the board of tellers: C. R. Hiers, *chairman;* J. P. Lyon, and W. O. Huebner. R. L. Stinard, chairman of the program committee, introduced the speaker, C. S. Leopold, consulting engineer, Philadelphia, who discussed *Internal Energy Release*

Effects in Conventional and Panel Cooling Systems. Mr. Leopold discussed the relation between actual and estimated cooling loads. The effects of heat storage in this structure and type of operation in reducing the peak load was explained by means of slides. In discussing radiant heat emission from lights of various types it was shown that cooling panels, even at room temperature or slightly above, could absorb a large percentage of the high temperature radiation. Following the discussion, which gave Mr. Leopold an opportunity to give further explanations based on his experience, he was given a rising vote of thanks. The meeting adjourned at 9:45 p.m. Attendance 160.

• **NORTH CAROLINA**—April 14, 1950. The North Carolina Chapter members met in conjunction with the Student Branch of North Carolina State College, Raleigh, at Withers Hall on the college campus. The meeting was called to order by J. J. Andrews, president of the Student Branch, who welcomed the members of the Chapter and then turned the meeting over to M. F. DuChateau, president of the North Carolina Chapter. Prof. C. A. McKeeman introduced M. F. Rather, vice president and export manager, Johnson Service Co., New York, who gave an enlightening talk on *Automatic Controls for Comfort and Industry.* Mr. Rather's talk was accompanied by slides illustrating various types of controls, their construction and applications. An open discussion period concerning various control problems followed his talk. The meeting adjourned at 10:00 p.m. Attendance 45. Attendance ratio 0.26.

• **NORTH TEXAS**—March 20, 1950. Pres. Herman Blum called the meeting to order in the Melrose Hotel and the minutes of the previous meeting were approved as read. F. L. Gray, Jr. of Carrier Corp., Dallas, introduced the guest speaker of the evening, James Moss of the York Corp. Mr. Moss outlined the history and usage of refrigeration machinery and equipment starting back in 1894 and bringing it up to present day refrigeration. According to Secretary R. E. Allison's report, Mr. Moss' talk was enjoyed by all present. President Blum expressed the appreciation of the Chapter to Mr. Moss. Attendance 85. Attendance ratio 0.42.

• **NORTHEASTERN OKLAHOMA**—March 13, 1950. Members and guests met at Smith's Restaurant for dinner preceding the meeting which was called to order by Pres. A. D. Holmes. Peter Barrett, speaker of the evening, gave a talk on *Cooling Towers.* After an interesting discussion period, the meeting adjourned at 9:00 p.m. Attendance 28. Attendance ratio 0.58.

• **NORTHERN OHIO**—April 10, 1950. Members and guests met in the Warner Auditorium and Pres. R. L. Byers presided at the April meeting. As a result of balloting, L. S. Ries was named chairman of the nominating committee with W. R. Moore and H. M. Nobis as his assistants. C. M. Humphreys introduced the speaker, R. S. Dill, chief, heating and air conditioning section, National Bureau of Standards, who spoke on *Thermal Insulation and Condensation in Buildings.* He presented a travelogue covering some of the institutions engaged in heating and ventilating research, including the National Bureau of Standards and emphasized the work being done on thermal insulation and vapor barriers. The lively discussion period that followed was evidence of the keen interest in the problem of condensation inside building walls and on interior surfaces. In the discussion, Mr. Dill pointed out that many of the winter condensation problems in existing installations could be relieved by the provision for ventilation by outside air. Attendance 130. Attendance ratio 0.25.

• **OKLAHOMA**—April 10, 1950. Pres. H. S. Shafer presided at the April meeting and after a few business items were discussed, introduced the speaker, F. R. Danner, manager of engineering construction of the Oklahoma Gas and Electric Co. He delivered a talk on *Construction and Design of the New Mustang Plant.* The meeting adjourned at 9:30 p.m. Attendance 52. Attendance ratio 0.36.

• **ONTARIO**—April 3, 1950. The April meeting was called to order by Pres. A. J. Strain at the Royal York Hotel. H. D. Henion, chairman of the nominating committee, announced the slate of officers to be elected for the coming year. Under the chairmanship of D. A. Stott, a panel discussion followed on *Heating and Ventilating of Schools.* Those participating in the panel were: P. A. Deacon, architect; R. E. Kinsinger, consulting engineer; G. S. McKernan, contractor; and K. E. O'Neill, manufacturer. A very interesting discussion followed. Attendance 111. Attendance ratio 0.46.

• **OREGON**—March 9, 1950. The meeting was held at the Old Heathman Hotel with Pres. J. P. McDermott as the presiding officer. The nominees for officers for the 1950-51 season as submitted by the nominating committee were unanimously approved and elected. The board of governors authorized the purchase of a gavel and this was arranged for, and a gavel made of Oregon myrtle was presented to the Society at the April Council meeting. President McDermott turned the meeting over to R. C. Chewning who reported on the Dallas Meeting. Mr. Chewning, in addition to his report on the meeting and on the technical papers presented, called on J. Donald Kroeker, E. R. Lokey, F. F. Urban, and E. A. Ponder to report on various other phases of the Annual Meeting. Attendance 105.

• **PHILADELPHIA**—April 13, 1950. Members and guests met at the Engineers' Club where Pres. F. H. Buzzard called the meeting to order.

The minutes of the previous meeting were read and approved along with the report of the treasurer. President Buzzard introduced Lester T. Avery, Cleveland, president of the Society, who gave a very interesting talk on the subject of *Dynamic Air Conditioning*. He covered phases of air conditioning for comfort and industrial purposes using slides to illustrate his talk. Mr. Avery's talk was thoroughly enjoyed by the members and guests, and an interesting discussion period followed. The following officers were unanimously elected for the coming season: *President*—J. W. McElgin; *First Vice President*—E. K. Wagner; *Second Vice President*—M. E. Barnard; *Secretary*—L. M. Church; *Treasurer*—C. F. Dietz. Attendance 98. Attendance ratio 0.36.

• **PITTSBURGH**—April 10, 1950. Pres. H. J. Kirkendall called the meeting to order in the Hunt Room of the Webster Hall Hotel. Following the reading of the minutes and the reports of the various committee chairmen, H. E. Park submitted the report of the nominating committee as follows: *President*—A. F. Metzger; *Vice President*—W. D. Simpson; *Treasurer*—B. B. Reilly; *Secretary*—E. H. Riesmeyer, Jr.; *Board of Governors*—H. J. Kirkendall, B. R. Small, H. A. Biber.

A. F. Metzger then introduced the speaker of the evening, T. C. Wurts, director of Allegheny County Bureau of Smoke Control who addressed the meeting on the *Smoke Control Ordinance*. Mr. Wurts spoke of the problems in selecting members of the Board. Men from the leading industrial field, as well as leading laymen, were selected and in turn they selected individuals from their own organizations to help solve problems. Mr. Wurts pointed out some of the highlights of the Ordinance and after the discussion he used slides to illustrate what had to be cleaned up in the county first. Attendance 41.

• **ROCKY MOUNTAIN**—April 5, 1950. The meeting at the Silver Wing Inn, Englewood, Colo., was opened by Pres. E. J. McEahern. The following were selected to serve as members of the nominating committee: N. H. Brickham, L. L. DeLong, C. M. Hook, William Van Genderen, and H. J. Woehlke, C. W. Savitz, project engineer, Air Maze Corp., Cleveland, gave a historical background of the discovery and development of static electricity and its present commercial use in attracting and repelling positive and negative particles of dust. Using a generator of static electricity, Mr. Savitz covered principles involved. He stated that:

> Your Denver mint is famous for being one of the first institutions in the world to make practical, big-scale use of this high-voltage electrical method of dust precipitation.
>
> Since the dust recovered contains gold, silver and other precious metals that otherwise would be lost up the flue, the Denver mint equipment pays for itself several times over every year.
>
> Recovery of precious metal dust from smelter smoke was the purpose behind construction of the old Grant smelter stack here. Today, modern electronic rectifiers could accomplish the same purpose without a 7,000-ton stack of bricks.

At the conclusion of his talk, a rising vote of thanks was given to Mr. Savitz. Attendance 43. Attendance ratio 0.31.

• **ST. LOUIS**—April 4, 1950. Pres. W. A. Russell opened the meeting at the York Hotel and called upon L. L. Hamig, treasurer, who reported on the finances. The members and guests then heard from a volunteer speaker on the subject of the needs of the St. Louis Children's Hospital which is putting on a drive for additions to their present facilities. This talk was followed by a sound track movie which illustrated the work of the Children's Hospital and demonstrated their extremely cramped quarters and need for larger facilities. J. W. Cooper, chairman of the nominating committee, presented his report of nominees for the 1950-51 season as follows: *President*—J. S. Rosebrough; *First Vice President*—C. H. Burnap; *Second Vice President*—H. C. Sharp; *Secretary*—L. L. Hamig; *Treasurer*—G. H. Bemarkt; *Board of Governors*—J. F. Naylor, Jr., Louis Steckham, W. A. Russell, H. F. Wilson.

F. J. Nunlist, Jr., chief engineer for the L. J. Mueller Furnace Co., Milwaukee, was introduced as the featured speaker. His talk was on the subject *Developments in Gas-Fired Central Heating*. Mr. Nunlist covered his subject in rapid fire style pointing out that automatic heating had shown a 60 percent expansion in the last three years and that the industry is moving in the direction of pre-assembled furnaces of smaller physical dimension with many new small capacity units added. He pointed out that of the automatic residential heating installations made last year, 490,000 were direct-fired air against 50,000 automatic boiler type systems.

Mr. Nunlist's talk was supplemented with slides which emphasized heating basementless houses with furnaces installed either in utility rooms or attic spaces. Several different types of panel or perimeter type systems were shown in which it was reported that 30 percent of the heat delivery was from panel radiation effect and the balance by convection. Several slides showed accepted methods of insulating the outside perimeter of the slab from inner perimeter, in order to reduce radiation losses to the outdoors.

The talk was followed by a question and answer period and a rising vote of thanks was given to Mr. Nunlist at 9:40 p.m. Attendance 76.

• **SOUTH TEXAS**—March 17, 1950. Sidney Bromberg reported as chairman of the membership committee and W. L. Barnes reported on the activities of the Engineers Council. R. H. Wittbold program chairman, then introduced W. N. Pauley, Farr Co., Los Angeles, who delivered an interesting talk entitled *The Theory and Practical Design of Air Filters*. Mr. Pauley divided the filter into four general types: fluid, dynamic, electrical precipitation, and filtration. He then brought out the basic difference in strainer and viscous impingement types of filters and then explained that design characteristics of air filters must take into account such items as capacity, resistance, efficiency, cost, maintenance and size. He further stated

that work was being pushed forward in an effort to devise an acceptable standard code for filters. In conclusion he emphasized that economics played an important part in the selection of the proper type filter. Attendance 66. Attendance ratio 0.37.

• **SOUTHERN CALIFORNIA**—April 19, 1950. Members and guests met at the Conde French Restaurant, Beverly Hills, for the April meeting. *Manufacturers' Views on Collaboration Between ASHVE Trades* was the topic of discussion with L. J. Helms, sales engineer, English & Lauer, Inc., Los Angeles, as the principal speaker. Mr. Helms discussed the issue which has been the theme of previous meetings from the standpoint of the equipment manufacturer and his representative. W. A. Stains represented the consulting engineer, and H. F. Ulovec represented the contractor in the discussion. Following the discussion, the latest motion picture of the Air Pollution Board was shown. Attendance 70. Attendance ratio 0.40.

• **SOUTHWEST TEXAS**—April 18, 1950. Pres. L. S. Pawkett presided at the April meeting held in the Cascade Room of the St. Anthony Hotel, San Antonio. The minutes were approved without reading. President Pawkett reported on the formation of the Inland Empire Chapter of the Society at Spokane and then announced the formation of the Student Branch at Oklahoma A & M College. A. J. Rummel and R. W. Kotzebue were elected members of the Board of Governors. F. C. Brandt, engineer, Minneapolis-Honeywell Regulator Co., Houston, was introduced by President Pawkett, and gave an excellent illustrated talk on the use and operation of the electronic control system and demonstrated the sensitivity and flexibility of such controls by use of actual equipment. The talk was well received and brought many questions from the audience which were ably answered by Mr. Brandt. Attendance 38. Attendance ratio 0.48.

• **SOUTHWEST TEXAS**—March 21, 1950. Members and guests met at the Plaza Hotel and President Pawkett presided. R. W. Barnes reported briefly on the work of the code committee and announced that codes of other cities were being obtained and studied. D. S. Cooper, consulting engineer from the South Texas Chapter, was introduced by Prof. W. E. Long. Mr. Cooper gave an interesting talk on *Coil Performance and Selection*, and warned that since many of the factors involved in the estimation of cooling load, especially, were only fair assumptions, it was necessary that particular attention be paid to the selection of cooling coils. His talk was well received and evoked many questions from the audience which were capably answered by Mr. Cooper. A lengthy discussion followed. The meeting adjourned at 9:45 p.m. Attendance 34. Attendance ratio 0.50.

• **VIRGINIA**—April 19, 1950. Pres. W. P. Robinson called the meeting to order in the office of Stokley Services, Norfolk. J. E. White, chapter delegate, gave a report on his trip to Dallas and outlined the activities of the Chapter Delegates' meetings in Dallas. Mr. White introduced the speaker of the evening, Finlay Ferguson, architect, associated with Colonial Williamsburg, who spoke on *Heating Requirements in Restoration Work*. He illustrated the lack of heating in colonial architecture by telling of a house with 14 fireplaces which used five loads of wood in one cold day and the people went to bed with their clothes on because they were still cold. He then told how some of the buildings in Williamsburg are now heated. He stated that The Palace, restored in 1932, uses the basement as a plenum and hot air is discharged through a narrow slot between the baseboard and the wall on the first floor. The Capitol, also restored in 1932, has hot air floor registers which are removed in the summer and the floor boards replaced. Some of the houses have corner cupboards with heaters hidden in them and heat is blown out the top of the cupboard. The most satisfactory heating method is to locate a convector under a window with the grille in the window stool. He mentioned that the biggest requirement in restoration work is to have a colonial architecture with all the modern conveniences included, but hidden from the people's view. Many interesting questions were asked and a very enjoyable discussion followed. Attendance 16. Attendance ratio 0.50.

• **WASHINGTON, D. C.**—April 12, 1950. The April meeting was held at Hotel 2400 with a social hour preceding dinner. The meeting was called to order by Pres. P. R. Achenbach. Messrs. R. A. Grant, W. O. King, and Rutcher Skagerberg were appointed the tellers of election. Mr. Grant announced later that the ballots had been counted and the following officers were elected for the 1950-51 season: *President*—F. M. Thuney; *Vice President*—R. K. Thulman; *Treasurer*—R. H. Loughran, Jr.; *Secretary*—I. M. Bortman; *Board of Governors*—P. R. Achenbach, J. G. Muirheid, W. C. Reamy, Jr.

President Achenbach then introduced P. B. Gordon, treasurer, Wolff and Munier, Inc., New York, N. Y. Mr. Gordon, a member of the Committee on Research, and chairman of the TAC on Panel Heating and Cooling, spoke on the subject *Panel Heating Research*. He described the objectives of his committee and reported results to date. It was evident by the number of questions put to Mr. Gordon that the subject was of particular interest. President Achenbach thanked the speaker for his excellent presentation and the meeting adjourned at 10:15 p.m. Attendance 31.

• **WESTERN MICHIGAN**—April 3, 1950. The April meeting of the Western Michigan Chapter was held in honor of the ladies. Pres. J. L. Alexander called the meeting to

order and the secretary read the report of the nominating committee. The motion was made and seconded that the slate of officers presented be accepted as follows: *President*—K. E. Robinson; *Vice President*—V. H. Hill; *Secretary*—F. W. Brundage; *Treasurer*—W. C. DeRoo; *Board of Governors*—J. L. Alexander, L. A. Calcaterra, H. R. Limbacher.

President-elect Robinson introduced Charles O'Conner, Reichold Chemical Co., who showed 16 mm film of his travels through Japan, China, Manila, and Honolulu. He gave a very interesting talk and by popular demand he graciously obliged the members by saying he would return at a later date and show additional films of his travels. Attendance 77. Attendance ratio 0.21.

• **WESTERN MICHIGAN**—March 13, 1950. The March meeting was held at the Post Company's dining room at Battle Creek with President Alexander presiding. Following a discussion on the Chapter Delegate and his duties, Frank Murry introduced the speaker of the evening, Fred Bridges, who is in charge of instruments at the Postum Plant. He gave a sketch on *A Random Day in the Life of an Instrument Engineer*, which was very much to the point. He also showed how air conditioning in the food processing is very important from the very beginning until the final stages of the product. Following the talk, members and guests were conducted on a tour of the Plant. A word of appreciation was given to Messrs. Murry and Kribbs for the hospitality extended by the Postum Plant and for their part in arranging for this meeting. Attendance 69. Attendance ratio 0.48.

• **WISCONSIN**—March 15, 1950. According to the report of the secretary, there was no formal meeting of the Wisconsin Chapter in March. However, an informal joint meeting was held combining the Wisconsin Chapter, The Engineer's Society of Milwaukee and the *Milwaukee Section* of the *ASRE*. Dinner was served in the Engineer's Society Building and the meeting then adjourned to the auditorium of the Wisconsin Electric Power Co. The meeting was called to order by A. G. Behling, president of the Engineer's Society of Milwaukee, who called upon F. J. Nunlist, a member of the Wisconsin Chapter, who introduced the speaker of the evening, L. J. Eck, vice president of the Minneapolis Gas Light Co. Mr. Eck's talk was on *Natural Gas and Its Application* to the Minneapolis area. To highlight his talk, a film entitled *The Eternal Flame* was presented, which covered the production and application of natural gas. Attendance 80.

STUDENT BRANCHES

▲ **CCNY**—March 30, 1950. Pres. Seymour Oestreicher called the meeting to order and no business was discussed at this meeting. The guest speaker, Ernst Graber, engineer, Minneapolis-Honeywell Regulator Co., New York, N.Y., spoke on the *Applications of Air Conditioning Controls*. Starting with a basic recirculating system, Mr. Graber described how the conditions of supply air could be controlled so that the specified room air conditions could be maintained. Room thermostats control the humidifier and the heating coils for a winter heating and ventilating system. For summer cooling, other controllers would regulate cooling, reheating and humidifying in the same system. Mr. Graber discussed modulating control of direct and indirect expansion cooling. In direct expansion cooling, he explained that air flows directly over the evaporator and the amount of refrigerant in the evaporator is regulated by control of the expansion valve. He further stated that in indirect expansion cooling, chilled water, maintained at constant temperature, is regulated by a valve which governs the amount of water in the cooling coil. In both cases, the valves are regulated by thermostats in the room and in the supply duct. Mr. Graber also explained the principles and operation of the bimetallic and bellows types of thermostats, and the hair and catgut types of humidistats. He described how pneumatic and electrical control systems function.

According to the secretary's report, it was generally agreed that Mr. Graber's talk was a very good supplement to the course in heating, ventilating and air conditioning given as part of the curriculum of the Mechanical Engineering Department. The meeting adjourned at 2:00 p.m. Attendance 33. Attendance ratio 0.66.

▲ **NORTH CAROLINA STATE COLLEGE**—April 14, 1950. Dinner preceding the joint meeting with the North Carolina Chapter was held in the Grill Room of North Carolina State Cafeteria. The meeting then adjourned to Withers Hall where the students and members were addressed by M. F. Rather, vice president and export manager, Johnson Service Co., New York, N.Y., on the subject *Controls for Comfort and Industry*. The meeting adjourned at 9:30 p.m. There was a total of 41 students and members in attendance.

▲ **NORTH CAROLINA STATE COLLEGE**—April 4, 1950. The meeting was called to order by Pres. J. J. Andrews in Page Hall and the minutes of the previous meeting were read and approved. The Chapter's fair committee reported on the progress of the Student Branch display at the Engineer's Fair. The nominating committee reported on the election of the officers for the 1950-51 season as follows: *President*—L. R. Wensil, Jr.; *Vice President*—Sid Narvey; *Secretary*—V. V. Crews; *Treasurer*—E. R. Malin; *Reporter*—S. W. Thomason. The meeting adjourned at 8:30 p.m. Attendance 24. Attendance ratio 0.54.

▲ **OKLAHOMA A & M COLLEGE**—March 16, 1950. The meeting was called to order in the Engineering Building and the featured speaker of the evening was Mr. Bas of the Water Cooling Equipment Co., Tulsa,

who spoke on *Cooling Towers*. Following the routine business W. H. Orr was appointed chairman of publicity for charter day, April 27. Professor Irwin reported on the arrangements for the charter day meeting, and a detailed discussion followed on the plans for that day.

▲ **OKLAHOMA A & M COLLEGE**—March 2, 1950. Pres. R. E. Metkier called the meeting to order and then introduced H. A. Atwater, Combustion Equipment Co., Kansas City, Mo. Mr. Atwater spoke on the *Application of Burners*, which was followed by an interesting discussion period. H. S. Shafer represented the Oklahoma Chapter of the Society and explained to the students that the Chapter held meetings on the second Monday of each month and invited the students to attend these meetings. Messrs. Stogner and Schiedt reported on the Engineering Exposition scheduled to be held in the late Spring. The meeting adjourned at 9:05.

▲ **PURDUE UNIVERSITY**—March 29, 1950. D. M. Williams, chairman of the Student Branch executive committee, opened the meeting in the Mechanical Engineering Building. Following the reading of the minutes, the meeting was turned over to R. L. Ford, chairman of the program committee, who introduced the speaker of the evening, R. G. James, I. W. Cotton Co., Indianapolis, Ind. Mr. James in his introductory remarks told some of the experiences he had had when he first began working for the company. The main topic of his talk was on combination of heating and cooling systems in a building. He described the split system that is designed upon the 20 deg temperature drop and gave his opinion on the pros and cons on this subject. He stated that there were three ideas that he thought could be followed in laying out a system: (1) use a minimum inlet air temperature of 120 deg, (2) attempt to use a two-speed blower by figuring the winter speed to be about one-half the summer speed, and (3) install enough wall heating source to prevent the forming of cold air puddles near the floor. Mr. James concluded his remarks by describing the layout of a garage with a reversed air temperature gradient. The meeting adjourned at 8:30 p.m. Attendance 29.

▲ **TEXAS A & M COLLEGE**—March 14, 1950. The Texas A & M Student Branch held a joint meeting with the students of the ASME. The meeting was called to order by J. E. Schumann, president of the ASHVE Student Branch, in the Mechanical Engineering Lecture room. Mr. Frederico, of the *ASME*, introduced Otto deLorenzi of Combustion Engineering Co., who gave a very interesting talk on combustion reactions that take place within the fire box of a steam generator. He showed movies to illustrate his talk and a short question and answer period followed. Attendance 68.

▲ **UNIVERSITY OF KANSAS**—April 27, 1950. Pres. J. L. Williams called the meeting to order in Lindley Hall at the University of Kansas and announced that this would be the last meeting of the year. C. H. Carr, consulting engineer of Kansas City, was the speaker of the evening. Mr. Carr's talk was entitled *Things You Don't Learn in Textbooks*. Throughout his talk he emphasized individual engineering initiative. His talk was followed by an open discussion with Mr. Carr acting as mediator. Attendance 18.

Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Executive Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Admission and Advancement Committee as soon as possible.

When the Admission and Advancement Committee has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month, 94 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Admission and Advancement Committee, and in turn, the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Executive Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by June 24, 1950, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Executive Secretary immediately after election.

ALLEN, W. E., Jr., Assoc. Engr., Wells & Meagher, Roanoke, Va. REFERENCES: R. L. Brown, R. V. Dodge, Jr., R. L. Meagher*, W. G. Wells*.

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OBITUARIES

ROBERT B. DICKSON

Kewanee, Ill.

Robert Barnes Dickson, Life Member of ASHVE and president and director of the Kewanee Boiler Corp., and a member of the board and of the executive committee of the American Radiator & Standard Sanitary Corp., died in Kewanee, Ill., on April 9, at the age of 67.

Mr. Dickson had been associated with the Kewanee Boiler Corp. for almost 45 years, and was a prominent figure in the heating field.

He was born in Streator, Ill., January 13, 1883, where he received his early education. In 1905 he became a bookkeeper for Kewanee Boiler Co., and later served as salesman, branch manager, vice president and general manager of sales. In 1930 he was named president and director of Kewanee Boiler Corp.

Mr. Dickson's business interests outside Kewanee Boiler and American-Standard included Emerit E. Baker, Inc., of Kewanee, of which he was a vice president and director. For years he was active in the Kewanee Chamber of Commerce, and served the Community Chest, Red Cross, and Salvation Army during their annual fund campaigns.

During World War II he served as coordinator of Kewanee's Council of Defense and had an important part in early plans for a new armory for Kewanee.

He was also a member of the *ASME*, of the Masonic Lodge at Galva and BPOE, and belonged to Midland Country Club, Knights Templar at Kewanee, Royal Arch Masons, Consistory at Moline, Ill., Mohammed Temple, Peoria, Ill., Illinois Chamber of Commerce, T.P.A. and Modern Woodmen of America, and had been active in Rotary.

He is survived by a son, James K. Dickson, Baltimore, Md., a daughter, Mrs. Dorothy D. Anderson, and a grandson, Jesse B. Anderson of Logan, Utah.

Funeral services were held at First Congregational Church of Kewanee on April 12, 1950.

LESLIE L. BYSOM

Bremerton, Wash.

The Pacific Northwest Chapter of the Society has announced the death of Leslie L. Bysom at Bremerton, Wash., on April 1, 1950.

He was born at Primghar, Ia., May 2, 1889, where he attended the Primghar High School. He received his bachelors' degree in engineering from Iowa State College, Ames., Ia., in 1912.

Mr. Bysom received his apprenticeship with C. A. Dunham Co., Marshalltown, Ia., where he worked as draftsman. Following three years with Proudfoot Bird and Rawson, architects, as mechanical draftsman, he was appointed estimator and draftsman for J. J. Hannigan Co., Omaha, Neb. In this connection he made plans for and gave engineering advice to many well known architects such as, Holabird and Root, D. H. Burnham, H. L. Stevens, Chicago, William Ittner, St. Louis, and Jarvis Hunt.

From 1917 to the time of his death he was mechanical engineer for the Public Works Design Section of the Puget Sound Navy Yard. His duties not only covered the Navy Yard proper, but the 13th Naval District, which includes the ammunition depot, torpedo station, naval air station in Seattle, and the radio and compass stations along the coast of Oregon, Washington and Alaska.

Mr. Bysom, a member of the Society for a period of twenty-four years, took an active interest in the affairs of the Pacific Northwest Chapter, serving in various capacities, and as president of the Chapter in 1948-49.

He is survived by his widow, of 1214 Eighth St., Bremerton, and two sons, Daniel and Robert.

JOHN J. McDONALD

Boston, Mass.

Word has been received of the death in February of John J. McDonald, Boston, Mass., a member of the Society over a period of 12 years. Mr. McDonald was born in Malden, Mass., in 1895.

A professional engineer in the state of Massachusetts, he spent a number of years with Duparquet, Huot and Maneuse Co., Boston, in charge of design and installation of kitchen, and heating and ventilating layouts and installations, and in 1924 he became manager of the Hotel Division of Mitchell Woodbury Co., also in Boston.

Since 1938 he has been manager of The McDonald Co., and the John Van Range Co., Boston, manufacturers of food service equipment, including special equipment and ventilation for railroad dining cars.

Mr. McDonald was president of the *Society of New England Food Service Equipment Industries.*

He is survived by his widow, of 401 Beacon St., Chestnut Hill, Mass., four sons and two daughters.

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• **SOUTHWEST TEXAS:** Organized 1946. Headquarters, San Antonio, Tex. Meets, Third Tuesday. PRESIDENT, L. S. Pawkett, 816 Insurance Bldg., San Antonio 5. SECRETARY, W. E. Long, Mechanical Engineering Dept., University of Texas, Austin.

• **UTAH:** Organized 1944. Headquarters, Salt Lake City, Utah. Meets, First Wednesday. President, C. E. Ferguson, 838 E. Garfield Ave., Salt Lake City. Secretary, A. R. Curtis, 2211 Highland Dr., Salt Lake City.

• **VIRGINIA:** Organized 1946. Headquarters, Norfolk, Va. Meets Third Wednesday. PRESIDENT, W. P. Robinson, 1442 Ocean View Ave., Norfolk 3. SECRETARY, D. E. Phillips, P.O. Box 674, Newport News.

• **WASHINGTON, D. C.:** Organized 1935. Headquarters, Washington, D. C. Meets, Second Wednesday. PRESIDENT, F. M. Thuney, 1919 K St., N. W., Washington 6. SECRETARY, I. M. Bortman, 422 Luray Pl., N. W., Washington 10.

• **WESTERN MICHIGAN:** Organized 1931. Headquarters, Grand Rapids, Mich. Meets, Second Monday. PRESIDENT, K. E. Robinson, 211 Smith Ave., Lansing 10. SECRETARY, F. W. Brundage, 512 N. Park St., Kalamazoo 11.

• **WESTERN NEW YORK:** Organized 1919. Headquarters, Buffalo, N. Y. Meets, Second Monday. PRESIDENT, F. J. Weber, 443 Delaware Ave., Buffalo 2. SECRETARY, J. M. Quackenbush, 505 Franklin St., Buffalo 2.

• **WISCONSIN:** Organized 1922. Headquarters, Milwaukee, Wis. Meets, Third Monday. PRESIDENT, F. J. Nunlist, Jr., 2005 W. Oklahoma Ave., Milwaukee 7. SECRETARY, N. E. Hill, 122 N. Hartwell Ave., Waukesha, Wis.

Student Branches

• **COLLEGE OF CITY OF NEW YORK:** Organized 1949. Headquarters, New York, N. Y. PRESIDENT, Seymour Oestreicher, 2009 Bryant Ave., New York 60. SECRETARY, Murray Goldman, 2075 Fulton St., Brooklyn 33.

• **LOUISIANA POLYTECHNIC INSTITUTE:** Organized 1949. Headquarters, Ruston, La. PRESIDENT, C. W. Gorton, 301 S. Trenton, Ruston. SECRETARY, A. L. Jones, Jr., Apt. 40, Vetville, La. Tech. Station, Ruston.

• **NORTH CAROLINA STATE COLLEGE:** Organized 1948. Headquarters, Raleigh, N. C. PRESIDENT, J. J. Andrews, 710 Harvey St., Raleigh. SECRETARY, E. A. Stroupe, Jr., 416 Halifax St., Raleigh.

• **OKLAHOMA A. & M. COLLEGE:** Organized 1950. Headquarters, Stillwater, Okla. PRESIDENT, R. E. Metzkier, 14-E Midi, Box 563, Veterans Village, Stillwater. SECRETARY, W. D. Jenkins, 801 W. Walnut, Enid.

• **OREGON STATE COLLEGE:** Organized 1949. Headquarters, Corvallis, Ore. Meets, First Wednesday after First Tuesday. PRESIDENT, M. B. Larson, 2311 N. E. Hancock, Portland 12. SECRETARY, Helen P. Lankow, 1349 S. E. Birch St., Portland 14.

• **PURDUE UNIVERSITY:** Organized 1948. Headquarters, W. Lafayette, Ind. CHAIRMAN, D. M. Williams, c/o W. T. Miller, Mechanical Engineering Bldg., Purdue University, W. Lafayette. SECRETARY, J. D. Tuttle, 359 Northwestern Ave., W. Lafayette.

• **TEXAS A. & M. COLLEGE:** Organized 1946. Headquarters, College Station, Tex. Meets, Second and Fourth Tuesday. PRESIDENT, John E. Schumann, Texas A. & M. College, General Delivery, College Station, Tex. SECRETARY, A. G. Seelke, Jr., Box 4251, College Station.

• **UNIVERSITY OF DETROIT:** Organized 1949. Headquarters, Detroit, Mich. Meets First Tuesday. PRESIDENT, L. M. Blanchette, 2245 Holcomb, Detroit 14. SECRETARY, S. H. Kosinski, 4439-30th, Detroit 10.

• **UNIVERSITY OF KANSAS:** Organized 1949. Headquarters, Lawrence, Kans. PRESIDENT, J. L. Williams, 5278 Central, Kansas City, Mo. SECRETARY, R. C. Umholtz, 2732 Michigan St., Topeka, Kans.

• **UNIVERSITY OF TEXAS:** Organized 1949. Headquarters, Austin, Tex. Meets, First and Third Tuesday. PRESIDENT, L. T. Davis, 4409 Avenue C., Austin. SECRETARY, A. G. Allen, 1537B, Brackenridge Apts., Austin.

WORTHINGTON AIR CONDITIONING REPORT

WORTHINGTON PUMP AND MACHINERY CORPORATION
HARRISON, NEW JERSEY

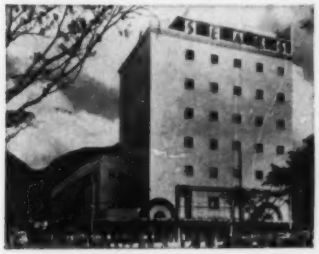
Specialists in air conditioning and refrigeration for more than 50 years

Cool Sears Gets Warm Reception In Rio

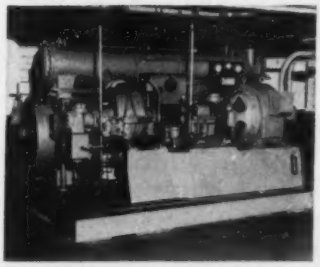
It was practically a fiesta day when Sears, Roebuck and Co. opened its new retail store in Rio de Janeiro.

At dawn before the opening the lines had formed, and before the day was through, 123,000 Brazilians had stormed the premises. First day's receipts were in excess of $500,000.

Among the attractions in this new Sears store is Worthington air conditioning, a welcome feature in Rio's semi-tropical summers. Chilled water for the air conditioning is supplied by a 55C66 centrifugal refrigeration system.



Sears, Roebuck store at Rio de Janeiro, Brazil, is air conditioned by means of Worthington centrifugal refrigeration.



Worthington centrifugal compressor in Sears, Roebuck's Trenton, New Jersey, store.

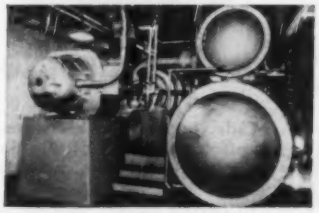
Meanwhile, another Sears store, closer by in Trenton, New Jersey, was being equipped with Worthington air conditioning, joining other Worthington-equipped Sears stores in Allentown, Pa., Atlanta, Ga., Kansas City, Mo., and Knoxville, Tenn.

How Insurance Company Insures Employee Morale

One of the biggest insurance companies in the country believes in insuring the happiness and efficiency of its personnel through air conditioning.

The new addition to the beautiful Omaha, Nebraska, home of the United Benefit Life Insurance Company, and its affiliates, is air conditioned throughout by a Worthington 75C99 centrifugal compressor with 727 ton capacity. This unit chills water, which is sent to air washers to control the temperature and humidity of the air, which is then distributed throughout the building. *Engineer: Charles S. Leopold, Philadelphia.*

Home office of the United Benefit Life Insurance Co., Omaha, Nebraska.



Worthington 75C99 centrifugal compressor at United Benefit Life Insurance Co.

Oilmen Strike It Lucky

In the heart of the "oil country," at Garland, Texas, an up-to-the-minute new plant has been opened by Emsco Derrick and Equipment Company to provide oilmen with the latest in such essential equipment as sucker rods, deep well plunger pumps, etc.

For greater comfort of visitors and employees, as well as peak performance, the finest air conditions are maintained in the offices, laboratories and engineering rooms by Worthington equipment.

Modern new plant of Emsco Derrick and Equipment Company at Garland, Texas.

The large area of the main office is serviced by a 3HF6 Freon-12 compressor unit with an ECZ-301 evaporative condenser, and an AHY-301 Air Conditioning unit. Two SCY package air conditioners, designed for compact areas, cool the small offices in the shop section.

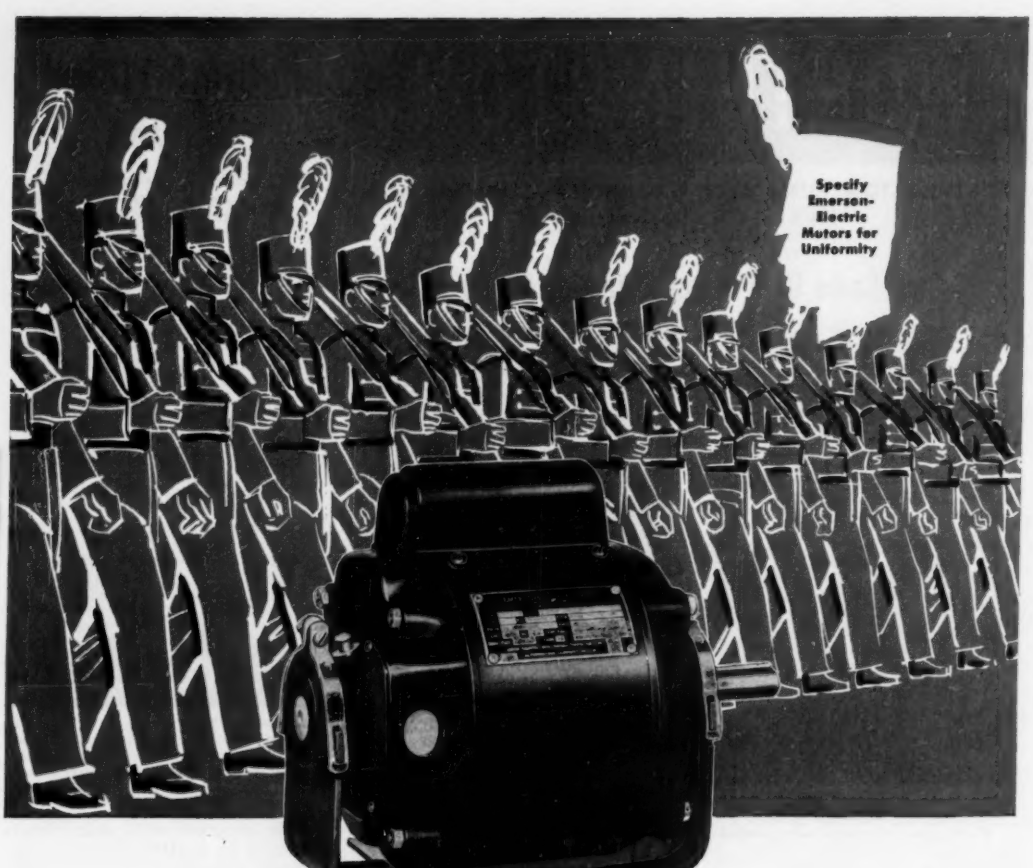
Architect: Fooshee and Cheek, Dallas

Worthington package air conditioner at Emsco.

WORTHINGTON

AIR CONDITIONING AND REFRIGERATION

A complete line . . . in which all the vital components are made, not just assembled by Worthington. For more worth with Worthington, see your nearby Worthington distributor (consult Classified Telephone Directory).



Each Motor Uniform in Appearance and Performance

Write for these Emerson-Electric Motor Data Bulletins

Appliance and equipment manufacturers, with applications for motors of 1/20 to 5 h.p., can profitably use these authoritative reference guides. Specifications, construction details and performance data are included for the following types:

- ☐ No. 351-A Capacitor-Start Motors
- ☐ No. 351-B Split-Phase Motors
- ☐ No. 351-C Integral Motors
- ☐ No. 351-D Fan-Duty Motors
- ☐ No. 351-E Oil-Burner Motors
- ☐ No. 351-F Jet Pump Motors
- ☐ No. 351-G Blower Motors

Cadets on parade present a precise, uniform appearance, but under their caps they are individually different.

In electric motors, however, uniformity in appearance is not enough—uniformity of *performance* is the true measure of their worth. The fact that Emerson-Electric Motors are uniform in performance is no coincidence, for behind each one stands a pioneer motor manufacturer with 60 years of engineering, and precision production experience.

Your products, too, demand this same uniform performance in addition to identical standards of appearance. It will pay you to consider Emerson-Electric Motors for the vital job of powering your product with unvarying efficiency and dependability.

Your inquiry is invited. Learn about the many advantages of Emerson-Electric Motors, 1/20 to 5 h.p.

THE EMERSON ELECTRIC MFG. CO.

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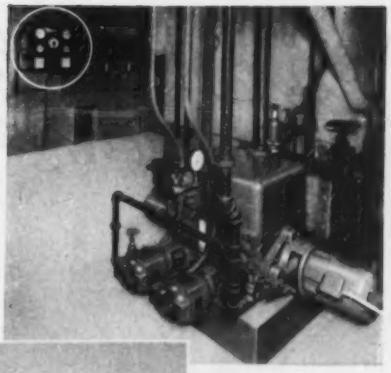
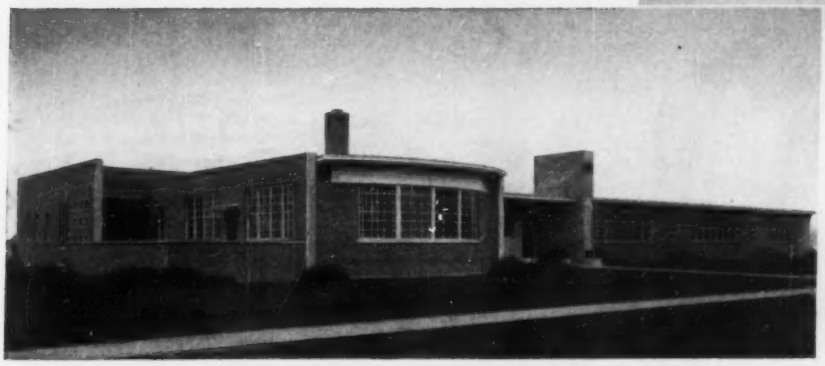
EMERSON ELECTRIC

MOTORS • FANS — APPLIANCES

ILLINOIS HEATING SYSTEMS





Boiler room view showing Type C Control Board which governs boiler steam pressure and temperature levels. The pump is a Duplex High Vacuum Unit actuated by the Selective Pressure Controller.

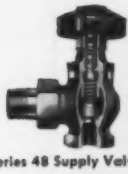
GRADE SCHOOL BUILDING, DIST. NO. U46, ELGIN, ILLINOIS
LEROY W. THOMPSON, A.I.A., *Architect and Engineer*
ELMER GYLLECK & ASSOCIATES, *Architects and Engineers*
A. J. IRONSIDES, *Heating Contractor*, all of Elgin, Illinois

GENERATION CONTROL
Type C System

Controlled steam *generation*
Controlled steam *circulation*
. . . . . a *double* economy

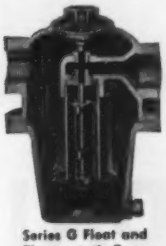
ILLINOIS Selective Pressure Control Systems are the *only* systems directly controlling fuel burning to permit steam generation, as well as circulation—below, at, or above atmosphere.

Installed in many of America's finest buildings, ILLINOIS Heating Systems have an outstanding reputation for fuel economy, comfort and convenience.



Series 48 Supply Valve

Series G Thermo Trap



Series G Float and Thermostatic Trap

Consult us on your requirements

ILLINOIS ENGINEERING COMPANY
INCORPORATED 1900
RACINE AVENUE AT 21ST STREET • CHICAGO 8

"I can seal a pipe joint in 13 SECONDS this NEW, easy way"

"IT'S SO EASY to seal pipe with POLYKEN Industrial Tape No. 290! There is no paste, brush, mixing or mess, just a single material in a single size — a 1½ inch x 36 yard roll of self-sealing **Fiberglas*** tape! You strip No. 290 around the seam, cut the roll loose and the seam is sealed for good — all in less than 15 seconds! The finished job is neat, and the seal actually *improves* with age."

TAPE NO. 290 is outstanding for pipe sealing because of the two unusual materials that make it up:

1. **Fiberglas*** cloth backing—tough, super-strong, resistant to heat, corrosion and aging.
2. Flame-resistant, thermo-setting adhesive. Self-sealing on any sheet metal. *Vulcanizes* under operational temperatures.

Write Dept. D-6 today, or phone your distributor or jobber for full information on Tape No. 290 and other **Fiberglas*** tapes specially designed for heating, piping and air conditioning.

7 REASONS WHY TAPE NO. 290 SEALS PIPE BETTER

1. **Speedy, safe, permanent seal**
2. **Sticks fast to any sheet metal**
3. **Absolutely non-corrosive**
4. **Increases structural strength of joints**
5. **No paste, no brush, no mixing, no mess**
6. **Clean, neat, permanent**
7. ***Actually costs less to install in many applications!***

*Fiberglas (Reg. U.S. Pat. Off. by Owens-Corning Fiberglas Corp.)

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DEPARTMENT OF

BAUER & BLACK

DIVISION OF THE KENDALL COMPANY

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Production Short Cuts to Reduce Costs • Research to Speed and Improve Methods

Industrial heating goes modern too!

Steel pipe is first choice for radiant heating advantages

Remember when a heating plant was just intended to keep folks warm? That day is gone!

Heating needs of modern business now go far beyond that of merely providing for human comforts. Today's heating systems must often function in capacities involving such requirements as quality of heat, consistency of temperature, preservation of humidity levels, conservation of space, and even psychological factors of health and efficiency.

Radiant heating has often proved the successful solution to such heating problems, and steel pipe, of course, is the logical choice for successful radiant heating systems.

There are many good reasons why. For one, steel pipe has more than 60 years of proved performance behind it in conventional hot water and steam heating systems. It has become almost standard material for this use. Then, too, steel pipe is economical, easy to form and weld, durable, and its expansion and contraction in concrete or plaster for all practical purposes may be considered the same.

Yes, steel pipe is first choice for radiant heating in modern industrial buildings, public buildings, schools, churches and homes.

This modern warehouse and operating building of The Peoples Natural Gas Company, Pittsburgh, Pa. incorporates a steel pipe radiant heating system for warmth, protection of delicate instruments and even for snow removal.

COMMITTEE ON STEEL PIPE RESEARCH
AMERICAN IRON AND STEEL INSTITUTE
350 Fifth Avenue, New York 1, N. Y.

NO, Doctor, there is no scientific laboratory formula for media selection. But experienced space buyers do have an effective and time-proven recipe for the profitable investment of advertising money—reasoning, judgement and experience PLUS THE USE OF FACTS. The basic advertising values of publications are reflected in the facts about their circulations. Also there are definite standards, mutually approved by buyers and sellers of advertising, by which circulations may be uniformly measured. Hence circulation facts, when reported in accordance with these standards, provide a dependable guide to sound advertising investments.

The information that makes it possible to measure advertising values based on circulation facts is given in the reports issued by the Audit Bureau of Circulations, a cooperative and nonprofit association of 3300 advertisers, advertising agencies and publishers. The Bureau has a staff of experienced, specially trained circulation auditors who make annual inspections and audits of the circulations of the publisher members. The factual data thus obtained is issued in the A.B.C. reports which are available to advertisers and agencies for use in comparing and selecting media.

Guesswork and waste in advertising are avoided when media is selected on the basis of the facts in A.B.C. reports. This business paper is a member of the Audit Bureau of Circulations. Ask for a copy of our A.B.C. report.

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Paid subscriptions and renewals, as defined by A.B.C. standards, indicate a reader audience that has responded to a publication's editorial appeal. With the interests of readers thus identified, it becomes possible to reach specialized groups effectively with specialized advertising appeals.

The audited information in A.B.C. reports for business papers includes the following:

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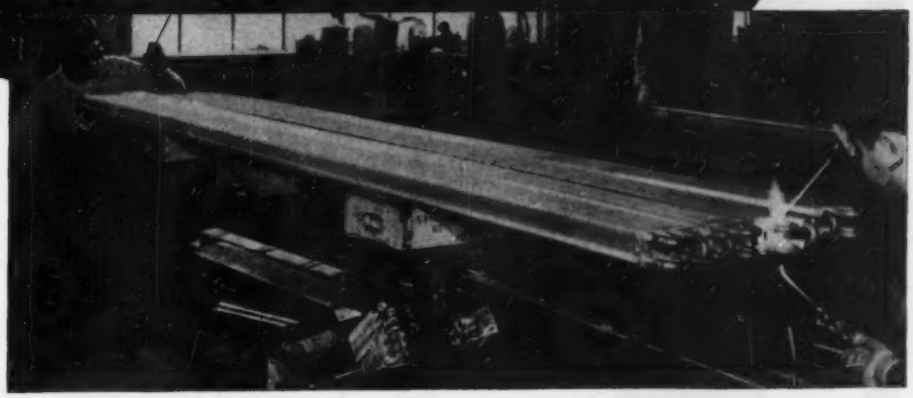
HEATING, PIPING & AIR CONDITIONING

A.B.C. REPORTS — FACTS AS THE BASIC MEASURE OF ADVERTISING VALUE

A *SURE* WAY TO GET LEAK-TIGHT JOINTS IN BRASS AND COPPER TUBING



BRAZE WITH *SIL-FOS*

Above you see the return bends on the two ends of a copper referigerating coil being brazed with SIL-FOS in the Kramer Trenton Co. plant, Trenton, N. J. This company turns out hundreds of coils of all types and sizes a week, with from 10 to 40 brazed joints per unit — every one brazed with SIL-FOS—and every one meeting a critical water pressure test.

Like so many other manufacturers of refrigerating equipment, Kramer Trenton use SIL-FOS because their experience has proved conclusively that this low temperature silver brazing alloy for non-ferrous metals is 100% reliable in making leak-tight joints—and does it fast and at a cost per joint that is pleasingly low.

BULLETINS 12-A AND 17 TELL YOU WHY AND HOW

Bulletin 12-A explains why leaktightness, strength and ductility are inherent in every SIL-FOS brazed joint. Bulletin 17 tells how to braze pipe and tubing with SIL-FOS. Write for copies today.

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DRY-EX WATER CHILLERS

Acme

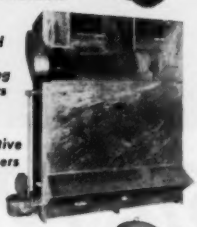
Designed For Ammonia or Freon

Acme Dry-Ex Water Chillers are provided in standard designs for all water ranges and quantities and for the full range of capacity requirements. They can be used with direct expansion ammonia as well as Freon for air conditioning systems and general industrial applications. Years of experience—with extra features and improvements—make Acme Dry-Ex Water Chillers outstanding for maximum performance and minimum service.

Heads are cast steel, shell is seamless steel tubing. Tubes are seamless copper (steel and alloy tubes available on special order). Built to comply with ASME Codes. To be safe, specify ACME—select from a wide variety of types and sizes shown in our Catalog No. 631.

Dry-Ex Water Chillers

Freon and Ammonia Condensers



Forced Draft Cooling Towers

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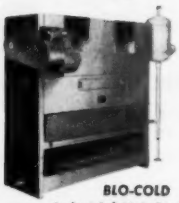


Pipe Coils

BLO-COLD Industrial Unit Coolers

Acme Dry-Ex Water Chillers have refrigerant space in tubes and heads—water space is in the shell. In many installations, savings in initial refrigerant charge will more than offset any additional chiller cost over that of flooded units. Model shown is DXG.

ACME INDUSTRIES INC.

Jackson, Michigan

Representatives in principal cities

Serving the refrigeration industry since 1919

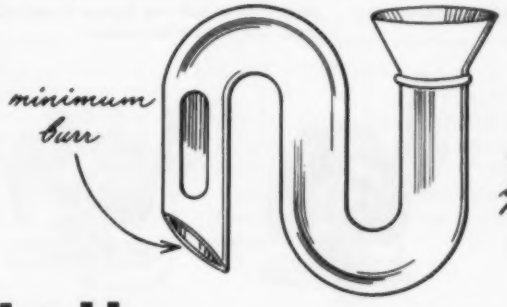
H&H means Quality and Service in Brass and Copper Tubing

and savings

A TYPICAL REPORT:

We used to fabricate our own tubular parts— Now, H+H experience and modern equipment are doing a better job—for less money!

Here's why it will pay you to talk over your fabricating problems with H & H. The shortcuts that they have developed during their 20 years of experience—the tools and other equipment that are available to you without an investment—the excellent redraw facilities that are maintained—all help H & H do a better job for less money. So why not call, wire or write H & H today?



Originators and sole makers of "Metalflo"— the economy tubing

H & H TUBE AND MANUFACTURING COMPANY

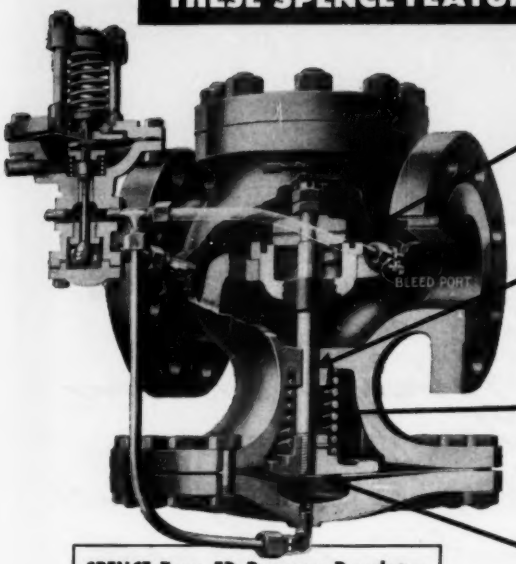
246 N. Forman Avenue • Detroit 17, Michigan • Vinewood 2-3600

METALFLO • LOCKSEAM • COIL STRIP AND SEAMLESS TUBING • TUBULAR PARTS

HERE'S PROOF

You Can Cut Costs of Pressure and Temperature Control

THESE SPENCE FEATURES SHOW YOU HOW



SPENCE Type ED Pressure Regulator

SECO METAL SEATS AND DISCS — Durable SECO Metal resists wiredrawing. *More than twenty years of experience* in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

PACKLESS CONSTRUCTION — All Spence main valves and most pilots are built without stuffing boxes. This minimizes friction . . . eliminates much time-consuming maintenance.

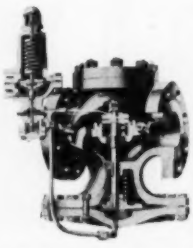
SPRING OUT OF PATH OF STEAM — The spring in the Spence Regulator is out of the path of the steam or other fluid flowing through the valve. It operates at low unit stress for exceptionally long life.

LARGE BALANCED DIAPHRAGM—Spence metal diaphragms, under usual conditions, never require replacement. Spence Regulators have few moving parts and those few are ruggedly constructed and seldom require attention.

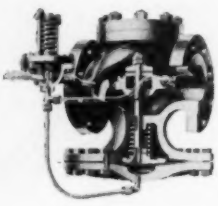
YOU BENEFIT by these and many other Spence features that assure *accurate, dependable* regulation year after year. That means *less down-time, less time and money wasted on replacement of parts.*

Spence Pressure and Temperature Regulators are built in sizes from *¼" to 12"* for service with *air, steam, water, oil or gas.* Only minor adjustments are needed to switch any Spence Regulator from one service to another.

Type BT150 Temperature Regulator—Taps in performance for both storage and instantaneous heaters.



Type EN Differential Regulator—Accurately controls differential between fluid delivered by regulator and some other source of pressure connected to the pilot spring chamber.



Type EQ Back Pressure Regulator — Completely packless, pilot operated for accurate control of the initial pressure.

These Companies Have Profited with SPENCE!

The Springs Cotton Mills
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Great Lakes Steel Corporation
Todd Shipyards Corporation
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General Electric Company
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and thousands of others

SPENCE ENGINEERING COMPANY INC.
WALDEN, NEW YORK

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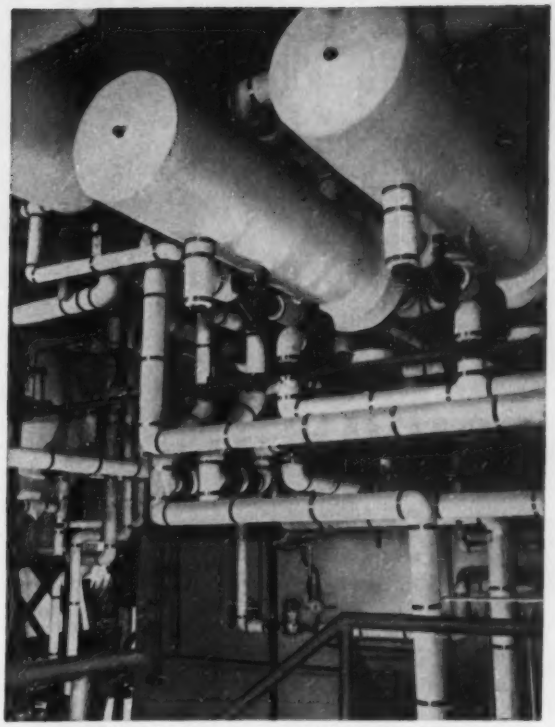
NOW! KEEP HEAT WHERE IT'S WANTED WITH THESE K&M INSULATIONS

Here you see two popular K&M Pipe Insulations— ***K&M DUPLEX*** *and* ***K&M "FEATHERWEIGHT"® 85% MAGNESIA*** *—used on the hot water supply and steam lines in a modern hospital. Consider what these K&M insulations can do for you:*



Efficient K&M Insulations on the job in a modern hospital.

K&M DUPLEX PIPE INSULATION—

Effective insulation for temperatures between 40°F. and 212°F. Use it for both hot and cold water pipes—one insulation for both uses simplifies stocking. K&M Duplex is formed of a continuous wrapping of specially creped felt, which forms countless heat-holding dead-air pockets. An inner liner of felt is saturated with a special waterproofing compound—condensation or seepage can't get through to damage the insulating layers. Single-layer K&M Duplex comes in thicknesses of ½", ¾", and 1"; and in sizes to fit all standard pipes. Double-layer K&M Duplex is furnished in thicknesses of 1", 1½", and 2". Supplied complete with canvas jacket and necessary brass lacquered bands. K&M Duplex is easy to cut and fit on the job—is easily and quickly erected.

K&M "FEATHERWEIGHT" 85% MAGNESIA PIPE INSULATION—For temperatures to 600°F. Here's the insulation for your low-pressure steam lines! K&M 85% Magnesia combines the high insulating properties of basic carbonate of magnesia, properly compounded with clean asbestos fibers. It's exceptionally light and extremely efficient—is mechanically strong and durable enough to withstand all ordinary usage. Thicknesses: Standard, 1½", 2", Double Standard (broken joint), and 3" (broken joint). Comes complete with canvas covering and brass lacquered bands. Use K&M 85% Magnesia Insulation for hot pipes needing a highly efficient, long lasting covering.

Get the complete story: Your K&M Distributor will be glad to give you further information on K&M DUPLEX, K&M "FEATHERWEIGHT" 85% MAGNESIA, or any of the other efficient pipe insulations in the K&M line. Consult him without obligation, or write us.

Nature made Asbestos . . .
Keasbey & Mattison has made it serve mankind since 1873.

KEASBEY & MATTISON
COMPANY • AMBLER • PENNSYLVANIA

Neat jobs like this

easy to form with U·S·S GALVANIZED SHEETS

HERE'S WHY: Uniform in ductility, flatness and coating, U·S·S Galvanized Sheets are easy to fabricate. You get true bends, tight seams and neat joints —even in forming the most difficult angles and shapes. And their tightly adhering coating of zinc assures long life and a finish that contributes to the pleasing appearance and salability of every job you turn out.

But workability is not the only reason for the tremendous popularity of these superior steel sheets. The most widely advertised and best-known sheets in the industry, they enjoy a public acceptance second to none. Customers know that the familiar U·S·S trademark stands for dependable quality.

To stand up under severe atmospheric conditions

U·S·S GALVANIZED COPPER STEEL SHEETS

—give twice the atmospheric corrosion resistance at little additional cost!

CARNEGIE-ILLINOIS STEEL CORPORATION, PITTSBURGH
COLUMBIA STEEL COMPANY, SAN FRANCISCO
TENNESSEE COAL, IRON & RAILROAD COMPANY, BIRMINGHAM
UNITED STATES STEEL SUPPLY COMPANY, WAREHOUSE DISTRIBUTORS, COAST-TO-COAST
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

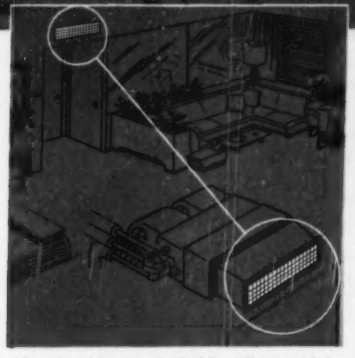
GALVANIZED STEEL SHEETS

UNITED STATES STEEL

TO BE TRULY MODERN A BUILDING MUST BE AIR CONDITIONED

Chrysler Airtemp air conditions the Shore Club Hotel

Architect: Albert Anis. Builder: 1901 Collins Corp., Irving Kipnis, President. General Contractor: Robert L. Turchin



Chrysler Airtemp Individual Room Units in the Shore Club Hotel are placed within the entrance ceiling with only the controls mounted on the wall.

INDIVIDUAL ROOM UNIT SYSTEM GIVES GUESTS CUSTOM CLIMATE

The new, ultra-modern Shore Club Hotel, at Miami Beach, offers a new degree of luxury and comfort for its guests. Each of the 150 rooms—as well as all public areas—have individually controlled units—for both heating and cooling. Fresh outside air is filtered and dehumidified for continuous circulation through this system. Chrysler Airtemp equipment was selected for this automatic control of indoor weather.

Here is another instance where Chrysler Airtemp has cooperated with architects, builders and contractors to give their clients the finest in air conditioning. Through regional offices and dealers in principal cities—Chrysler Airtemp offers trained engineers to aid you with any heating or cooling operation—from the initial plans to the final installation.

When desired, Airtemp Construction Corporation—wholly owned subsidiary of Chrysler Corporation—will assume complete responsibility for all or any part of your air conditioning project. You'll find additional information on Chrysler Airtemp service and products interesting—and rewarding. Mail coupon today for full details.

CHRYSLER AIRTEMP
DIVISION OF CHRYSLER CORPORATION

Chrysler Airtemp

AIR CONDITIONING • HEATING • COMMERCIAL REFRIGERATION

3 BASIC SYSTEMS TO MEET EVERY AIR CONDITIONING NEED—
CENTRAL SYSTEMS • INDIVIDUAL ROOM UNITS • "UNITEMP"

AIRTEMP DIVISION OF CHRYSLER CORPORATION, Dayton 1, Ohio
We would like the story of Chrysler Airtemp service and products.
Name _____
Address _____
City _____ Zone _____ State _____
HP&AC-6-50

TO DO A BETTER PIPING JOB...

USE

GLOBE

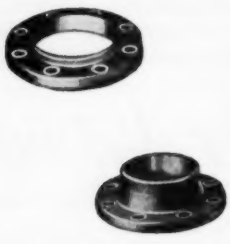
PRECISION PROCESS SEAMLESS WELDING FITTINGS

Your preference for Globe Welding Fittings is supported by a source of supply with exceptional qualifications. Specialized metallurgical experience and facilities gained in years of steel tubing manufacture enable Globe to produce welding fittings by a precision process that yields a superior product.

Send for the Globe Welding Fittings Catalog No. 501.

GLOBE STEEL TUBES CO., Milwaukee 15, Wisconsin

Chicago — Cleveland — Detroit — New York — Philadelphia — St. Louis — Tulsa — Houston — Denver — San Francisco — Glendale, Calif.



Producers of Globe Seamless Stainless Steel Tubes —Gloweld Welded Stainless Steel Tubes—Carbon — Alloy — Seamless Steel Tubes — Globeiron Seamless High Purity Ingot Iron Tubes and Pipe.

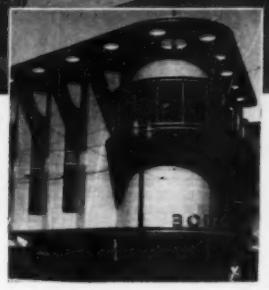
SIZE RANGE OF GLOBE SEAMLESS WELDING FITTINGS

Description of Fitting	Standard Weight (Schedule 40)	Extra Strong (Schedule 80)	(Schedule 160)	Double Extra Strong
Elbows 45° Long Radius	½ in. to 24 in.	¾ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Elbows 90° Long Radius	½ in. to 24 in.	¾ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Elbows 90° Short Radius	1 in. to 24 in.	1½ in. to 24 in.	- - -	- - -
Returns 180° Long Radius	½ in. to 24 in.	1 in. to 24 in.	1 in. to 12 in.	3 in. to 8 in.
Returns 180° Short Radius	1 in. to 24 in.	1½ in. to 24 in.	- - -	- - -
Reducers (Concentric and Eccentric)	1 x ⅜ in. to 24 x 20 in.	1 x ⅜ in. to 24 x 20 in.	1 x ⅜ in. to 12 x 10 in.	1 x ⅜ in. to 12 x 10 in.
Tees Straight	¾ in. to 24 in.	¾ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Tees Reducing Outlet	¾ in. to 24 in.	¾ in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.
Stub Ends Lap Joint	1 in. to 24 in.	1 in. to 24 in.	- - -	- - -
Caps	1 in. to 24 in.	1 in. to 24 in.	1 in. to 12 in.	1 in. to 8 in.

Flanges available 1 inch to 24 inches in all weights

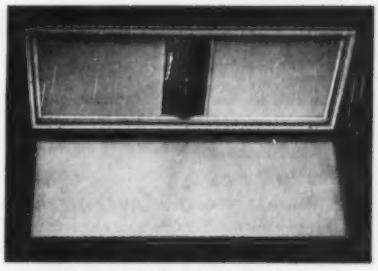
For *complaint-free* low velocity air distribution

BOND CLOTHES, CLEVELAND, OHIO.
Multi-Vent panels, barely discernible, installed flush in plaster ceilings throughout the building.



Use the Best...

Use
MULTI-VENT *Ceiling Panels*
T. M. Reg. U. S. Pat. Off.



Though the cost of supply and return air outlets is a very small percentage of the overall cost of a good air conditioning system, economizing in the selection of air distribution media is often the cause of complaints from clients on drafts, uneven temperatures, insufficient air, noise and dirty ceilings.

Multi-Vent is better able than any other diffuser to provide widespread uniform air distribution, without these common objectionable conditions because the basic draft, noise and dirt hazards, inherent in all other diffusers, are non-existent in the unique Multi-Vent principle of *distributing air entirely by displacement rather than by high velocity injection.*

In distribution by displacement there are *no* strong air streams to aim and *no* change in air flow pattern when air supply is varied. Regardless of room size, ceiling heights and relative positions of partitions, beams, etc., *all problems of outlet location and air direction adjustments for throw and drop to avoid drafts are eliminated.*

Multi-Vent, moreover, can handle greater amounts of air in proportion to room size than any other diffuser and still maintain a rate of air motion low enough to meet not only the most exacting comfort zone requirements but also to solve the high load and high ventilating problems in critical laboratory and industrial processing areas.

Multi-Vent has many other advantages such as savings in basic heating, cooling and air handling equipment in addition to the important installation, maintenance and decorating economies.

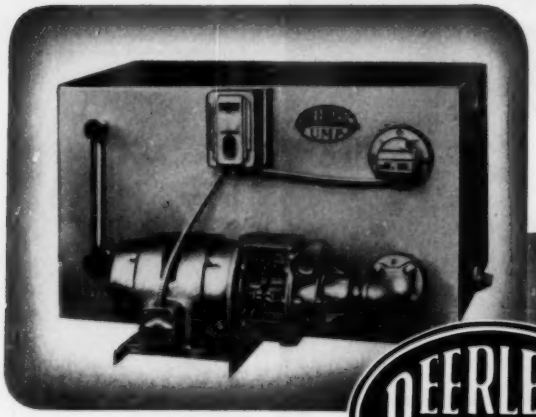
Write for detailed literature and the name of our sales engineer in your vicinity.

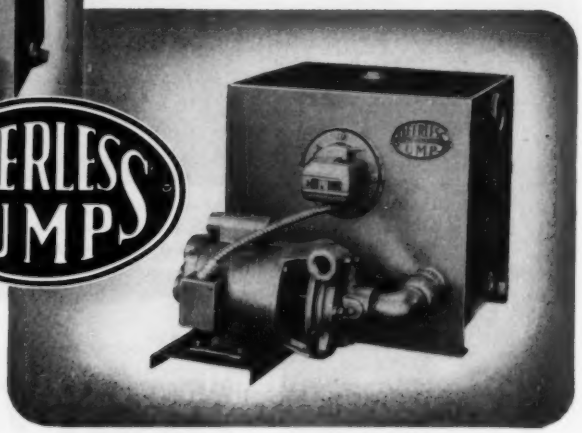
MULTI-VENT DIVISION • THE PYLE-NATIONAL COMPANY 1373 N. KOSTNER AVE., CHICAGO 51, ILL.

YOUR ENTIRE AIR CONDITIONING SYSTEM WILL BE JUDGED BY THE PERFORMANCE OF THE OUTLETS

BUY THE CONDENSATE RETURN UNITS BUILT BY THE MAKERS OF PEERLESS PUMPS

Your Certification of High Quality, Low Cost and Peak Performance





PEERLESS PUMPS

SIMPLEX AND DUPLEX UNITS FOR CAPACITY RANGE OF 1000 TO 100,000 EDR • PRESSURES: 20, 30, 40 LBS.

PEERLESS

CONDENSATE RETURN PUMPS

You can get both highest quality and low cost by insisting on Type PC Peerless units, made by the manufacturer of famous Peerless Pumps.

Peerless quality is quickly evident throughout these condensate receiver units. The pumps that power these units are close-coupled, bronze fitted vertically split case design, proved by Peerless in thousands of installations.

Refinements in design for pumps of this type include the use of stainless steel shaft and a positive-action mechanical shaft seal on all units from ⅓ to 1 h.p. inclusive. Receiver tanks are constructed of heavy gauge, copper bearing steel, accurately welded and pressure tested. No special base plate or foundation is required. Air circulating space is provided between floor and receiver tank, helping to eliminate corrosion due to wet floors.

All Peerless condensate units are furnished complete ready for service. If you want quality with day-after-day economy and dependability, specify and buy Peerless Type PC Condensate Return units. Peerless distributors are located in all principal cities for service and engineering help. A descriptive Bulletin, complete with rating tables and full specifications on all models is available upon request. Write today for Bulletin B-2201.

SPECIFICATIONS

Simplex Units

⅓ and ¾ h.p. at 20 and 30 lbs. discharge pressure with capacity rating of 1,000-10,000 EDR.

Receiver Capacity: 16 gallons.

Simplex and Duplex Units

⅓-5 h.p. at 20, 30 and 40 lbs. discharge pressure with capacity rating of 10,000-100,000 EDR.

Receiver Capacities: 30-98 gallons.

fmc

PEERLESS PUMPS

PEERLESS PUMP DIVISION

FOOD MACHINERY AND CHEMICAL CORPORATION

Factories: Los Angeles, California, and Indianapolis, Indiana.
Offices: New York, Atlanta, Fresno, Los Angeles, Chicago, St. Louis, Phoenix, Dallas, Plainview and Lubbock, Texas.

FLIP FOLD FOR STAYNEW'S EXCLUSIVE FEATURE

Staynew AUTOMATIC AIR FILTERS

First in

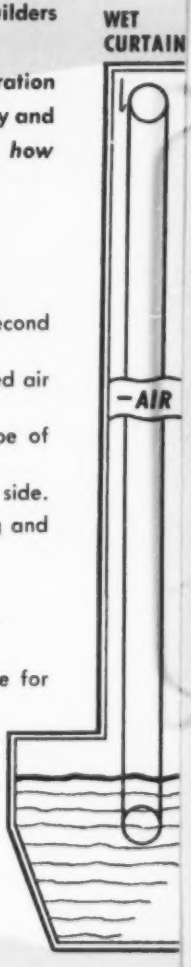
- **LOW INITIAL COST**
- **HIGH OPERATING EFFICIENCY**
- **LOW MAINTENANCE COST**

In factories, office buildings, institutions and commercial establishments, Staynew Automatics give better results at less cost . . . as proven by the steadily increasing number of modern builders who specify Staynews exclusively.

If your building problem requires the filtration of large volumes of dirty air at high efficiency and low cost, let Staynew engineers show you *how* and *why* Staynews are your answer.

No Other Air Filter Can Give You These 10 Important Features

1. *Double* filter curtains—the first wet, the second dry. *No* oil entrainment.
2. Cleaned side of curtains always on filtered air side.
3. Highest efficiency of any mechanical type of self-cleaning filter.
4. Motor and controls mounted on clean air side.
5. Momentary contact time switch for testing and checking.
6. Shear pin protection of moving parts.
7. Remote mounting of control unit if desired.
8. Gear and roller chain drive.
9. Compressed air curtain cleaners available for special conditions.
10. Nationwide service on motor and controls.

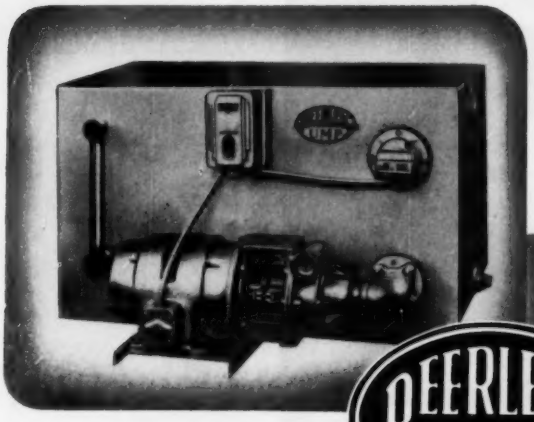


WRITE FOR SPECIAL BULLETIN LHS
providing complete information, including capacity, dimension, and performance data.

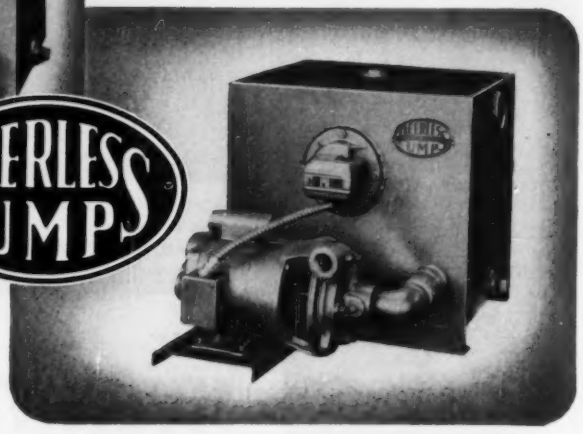
DOLLINGER CORPORATION
60 CENTRE PK., ROCHESTER 3, N. Y.

DOLLINGER PROTECTOMOTOR STAYNEW FILTERS

BUY THE CONDENSATE RETURN UNITS BUILT BY THE MAKERS OF PEERLESS PUMPS



Your Certification of High Quality, Low Cost and Peak Performance



PEERLESS PUMPS

SIMPLEX AND DUPLEX UNITS FOR CAPACITY RANGE OF 1000 TO 100,000 EDR • PRESSURES: 20, 30, 40 LBS.

PEERLESS

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fmc

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FLIP FOLD FOR STAYNEW'S EXCLUSIVE FEATURE

Staynew AUTOMATIC AIR FILTERS

First in

- **LOW INITIAL COST**
- **HIGH OPERATING EFFICIENCY**
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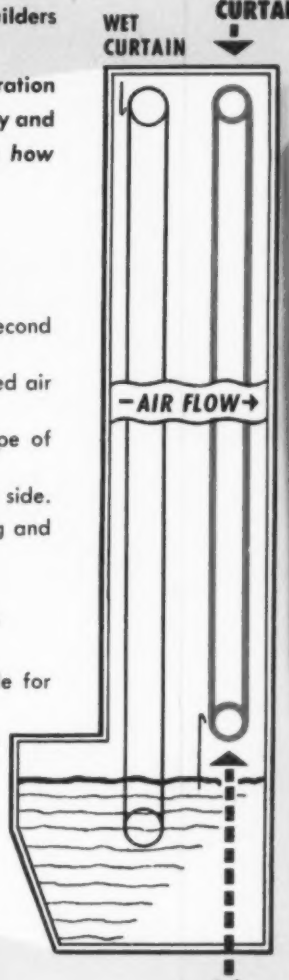
5. Momentary contact time switch for testing and checking.
6. Shear pin protection of moving parts.
7. Remote mounting of control unit if desired.
8. Gear and roller chain drive.
9. Compressed air curtain cleaners available for special conditions.
10. Nationwide service on motor and controls.

Only STAYNEW Has This DRY CURTAIN!



Only STAYNEW Has This DRY CURTAIN!

WRITE FOR SPECIAL BULLETIN LHS **providing complete information, including capacity, dimension, and performance data.**

DOLLINGER CORPORATION
60 CENTRE PK., ROCHESTER 3, N. Y.

DOLLINGER PROTECTOMOTOR STAYNEW FILTERS

STAYNEW
PANEL FILTERS

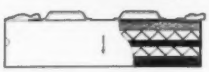
Dry-Type * Viscous-Type

designed for a broad range of prices and applications

Simple, efficient designs and rugged construction are featured. Most types provide for cell and frame assemblies, with heavy, serviceable handles and powerful cam-type locking latches. 18-gauge steel is used throughout. Supporting frames are so designed and drilled that they can be riveted together to form a flat bank. By the addition of angles, a series of "V's" can be formed. All models typify the high efficiency and low maintenance cost for which Staynew Filters have been famous since 1920.

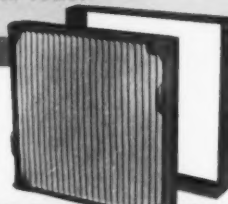
MODEL PVG
VENTILATION FILTER . . .

● A low-cost, permanent, washable type filter. Designed for maximum use of medium with minimum of weight. Exclusive Staynew "RL" steel medium causes rapid changes in air direction and holds heavier particles. Finer particles are held by corrugated screen cloth and, as a final stage, layers of fine woven copper mesh. 2″ and 4″ units available.



Cross Section of Medium

MODEL WKE
VENTILATION FILTER . . .



Easy to clean by vacuum

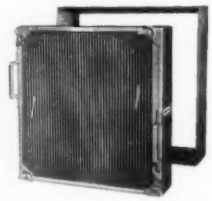
Filtering medium replaceable at low cost

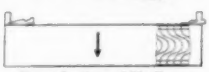
Staynew Vacuum Cleaning Nozzle

Especially designed for heavy duty industrial applications. "V" construction provides large filtering area in small space. Wide variety of media available. Cleaning simple and easy with Staynew Saddle-type Vacuum Cleaning Nozzle. 2″ and 4″ deep units available. Fire Underwriters Class I Approved when used with B-G Medium.

MODEL SPB
SPRAY BOOTH FILTER . . .

DRY OR VISCOUS DEPENDING ON KIND OF PAINT USED. Removes paint spray particles from the ventilation air stream by means of a series of scientifically designed baffles. These baffles cause rapid changes in direction of air-flow and consequent impingement of particles, which collect and drain to the bottom of the unit.



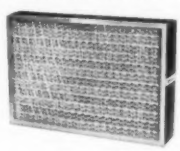


Cross Section of Medium

NEW! MODEL PVR
KITCHEN RANGE FILTER

Solves the problem of grease collection in exhaust hoods over ranges, steam tables or cookers. Eliminates fire hazard and odorous, unsanitary conditions. Exclusive Staynew "RL" steel filtering medium. Available in 3″ deep units. *Lowest cost high grade range filter.*

Panels easily removed for cleaning in hot, soapy water. Automatic dishwashing machine ideal for this purpose.



DOLLINGER PROTECTOMOTOR STAYNEW FILTERS

Representatives in Principal Cities

★

Write for Complete Data, Mentioning Special Interests

DOLLINGER CORPORATION, 60 Centre Pk., Rochester 3, N. Y.

Since 1889

61 Years of Progress and Development

nyb

Make-Up AIR Unit

Corrects Air Starvation

Where gases, dust and fumes are removed in large volume with exhaust fans, depleting the air supply within the building, and creating a minus pressure, we recommend the installation of our Make-Up AIR Units.

These simple, compact, ceiling suspended units replace the air from the outside, in an even and constant flow, without drafts or noise; warmed, cleaned and delivered in definite known quantities to balance the known loss. Corrects drafty conditions and uncontrolled infiltration. Furnished in 4 sizes from 5,000 CFM to 20,000 CFM.

Bulletin 502 gives full details.

All NEW YORK BLOWER COMPANY products are laboratory tested, accurately rated and fully guaranteed in strict accordance with Standard Test Codes.

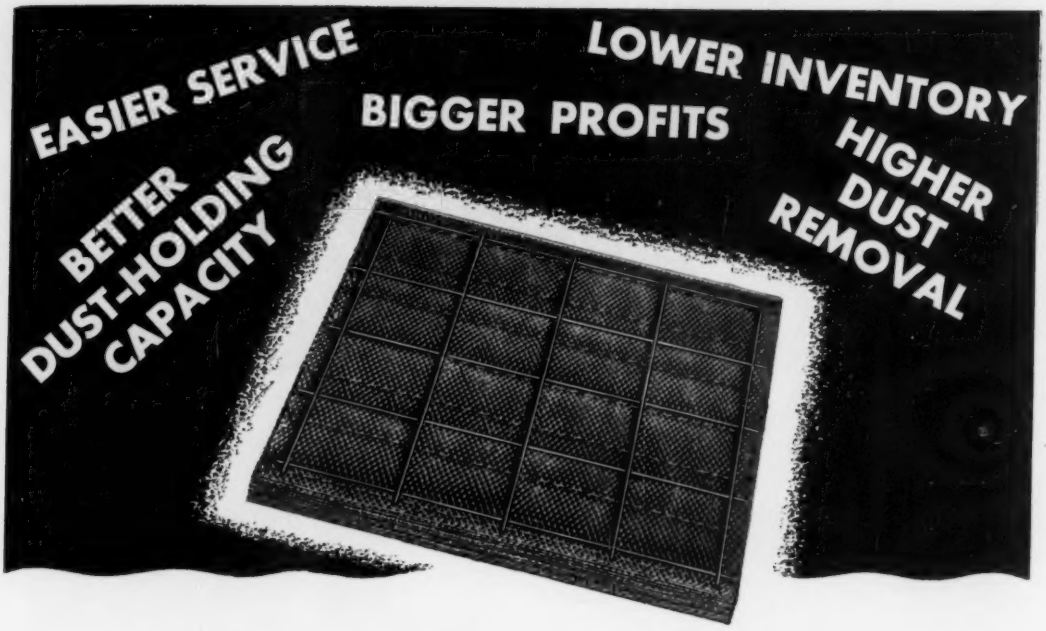
IUHA

nyb

THE NEW YORK BLOWER COMPANY

GENERAL OFFICES • 32nd STREET & SHIELDS AVENUE • CHICAGO - 16

FACTORIES AT LAPORTE, INDIANA AND CHICAGO, ILLINOIS



It's a better filter from every angle!

Judge it from any angle . . . the R-P Self Seal Filter is a better deal for you! Built slightly oversize, it fits snugly into filter holder with a self-seal edge. Larger sized pads can be cut down slightly to fit smaller grids already installed—thus lowering pad inventory. Save the grids—replace only the filter pad—pocket the difference in *profit!* Write for data sheets on dust removal efficiency and dust holding capacities. Research Products Corporation, Madison 10, Wisconsin, Dept. H.

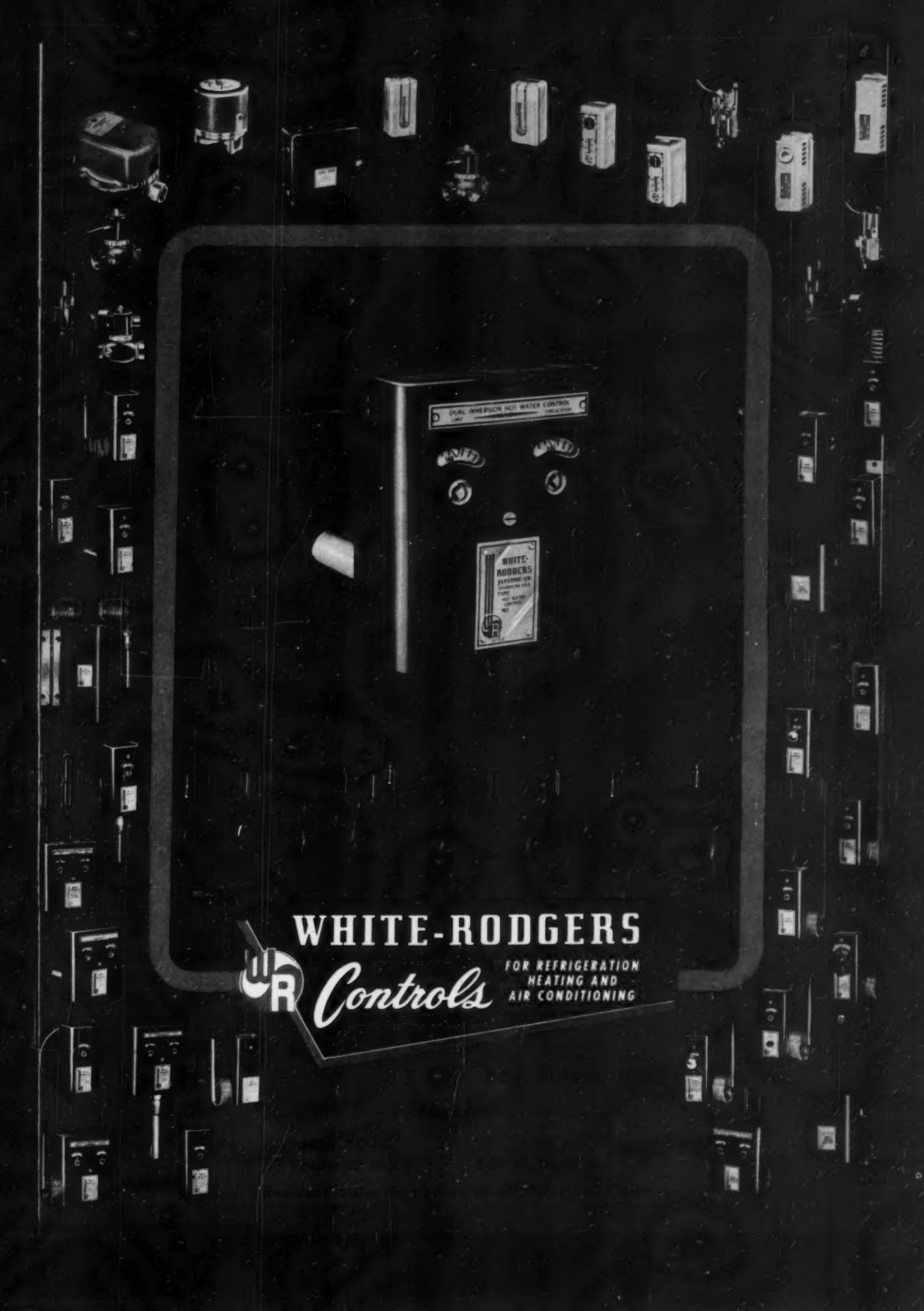
(Canadian Representative—Delhi Industries, Delhi, Ontario)

RP *Self Seal* FILTER

for heating, ventilating and air conditioning systems

RP . . . PRODUCTS OF RESEARCH

WASHABLE AND REPLACEMENT AIR FILTERS • GREASE FILTERS • EVAPORATIVE COOLER MATERIALS


DUAL IMMERSION HOT WATER CONTROL
WHITE-RODGERS
WHITE-RODGERS
Controls
FOR REFRIGERATION
HEATING AND
AIR CONDITIONING

Humphrey GAS UNIT HEATERS

are ECONOMICAL • QUIET • DEPENDABLE

Humphrey Unit Heaters combine all the features that add up to easy-to-make sales and satisfied customers . . . comfort, economy and styling that harmonizes with any surroundings. When you sell Humphrey, you sell with the kind of assurance that is backed by over 50 years of experience in designing and building highest quality gas heating equipment. Write today for new literature on Humphrey gas fired Unit Heaters.

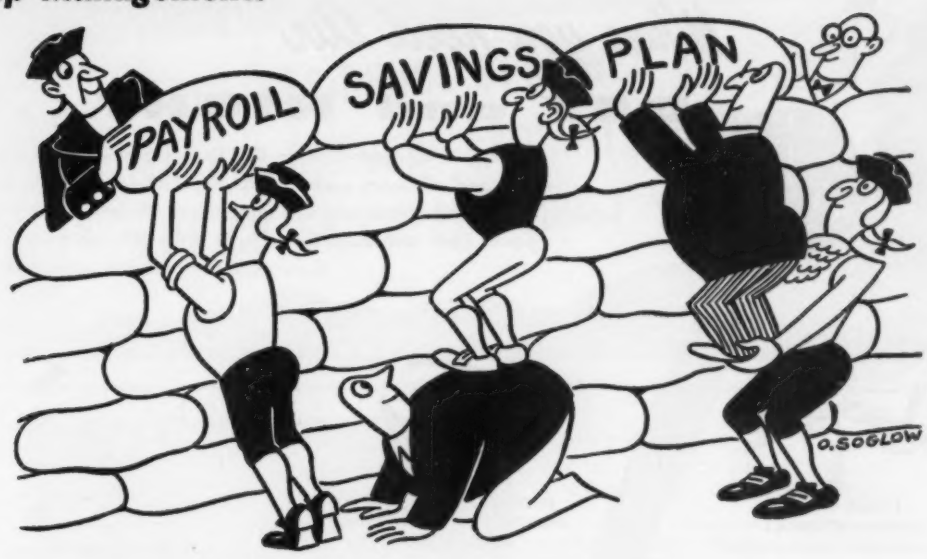
GENERAL GAS LIGHT COMPANY

KALAMAZOO, MICHIGAN

A HUMPHREY PRODUCT

23 WARREN STREET, NEW YORK CITY • 2nd UNIT SANTA FE BLDG., DALLAS • 225 ELEVENTH STREET, SAN FRANCISCO

Top Management:



YOUR BOOST IS NEEDED MOST

IN THIS CAMPAIGN TO BUILD *EVERYONE'S* INDEPENDENCE

The period May 15-July 4 marks an important campaign to strengthen the financial independence of the nation's people—and there's nothing of more basic importance to your own and your company's future than the country's economic well-being! What's more, you and other leaders of industry are the men who will be the principal deciders of the success of this campaign.

For this is the Treasury Department's *Independence Drive* to increase purchases of United States Savings Bonds. And the Payroll Savings Plan, now operated by 21,000 companies, is responsible for the greatest share of Series E Bond sales.

If your company doesn't have the Payroll Savings Plan, now's the time to install it! (A nation-wide survey shows that people are more than twice as inclined to invest their extra money in Savings Bonds as in any other form of investment. So it's good "employee relations" to provide this convenience.)

If your company does have the Plan, now's the time to put extra push behind it! Employees who pile up money in Savings Bonds feel more secure... are actually better workers. Moreover, Bond sales build a backlog of future purchasing power—good "business insurance" for all of us in the years ahead.

The Independence Drive will be powerfully promoted throughout the nation by radio, television, publication advertising, posters, car cards, and special ceremonies. The public will be *extra* Bond-conscious during this period. Make sure your company adequately informs your employees that the convenience of "automatic" Bond buying is available through your Payroll Savings Plan.

This is your country—and it's *your Drive.* Help to put it over! All the material and assistance you need are available from your State Director, Savings Bonds Division, U.S. Treasury Department. Remember—employees *appreciate* Payroll Savings.

The Treasury Department acknowledges with appreciation the publication of this message by

HEATING, PIPING & AIR CONDITIONING

BOOST BONDS FOR INDEPENDENCE · PROMOTE PAYROLL SAVINGS ·

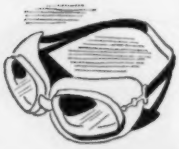
This is an official U. S. Treasury advertisement prepared under the auspices of the Treasury Department and The Advertising Council.

When you need Air

DAY and NIGHT . . .

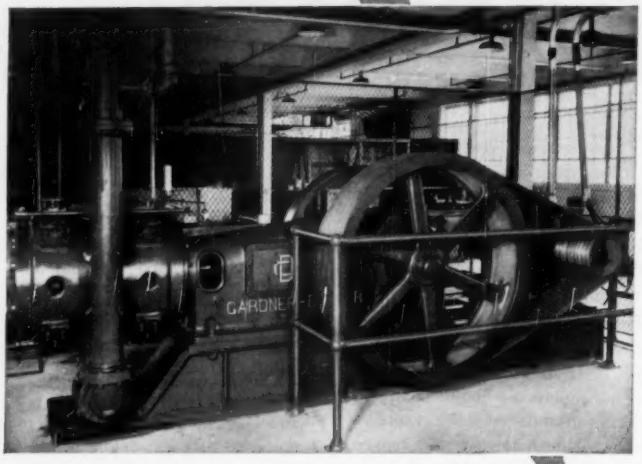
Choose a Gardner-Denver RX Compressor — famous for economy and efficiency under continuous, full-load, heavy-duty service. You'll find volumetric and mechanical efficiencies are high — power costs unusually low. Check these RX advantages — then write for complete information.

LARGE VALVE AND PORT AREAS
ASSURE UNRESTRICTED AIR FLOW



ENCLOSED MAIN FRAME
PROVIDES PROTECTION AGAINST DUST AND DIRT

AIR-CUSHIONED VALVES
QUIET, DURABLE, AND EFFICIENT



AUTOMATIC LUBRICATION
POSITIVE AND TROUBLE FREE

AUTOMATIC CONTROL
LIMITS POWER CONSUMPTION TO AIR DEMAND

WIDE RANGE OF SIZES
ASSURES CAPACITY AND PRESSURE TO FIT YOUR NEEDS EXACTLY

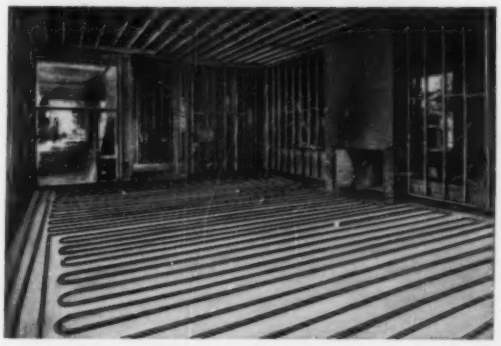
Gardner-Denver RX Single-Stage, Water-Cooled Compressors are made in capacities from 89 to 1292 cubic feet displacement per minute, for pressures from 20 to 150 pounds. Write for illustrated bulletin.

Since 1859

GARDNER-DENVER

Gardner-Denver Company, Quincy, Illinois
In Canada: Gardner-Denver Company (Canada) Ltd., Toronto, Ontario

LARGE RESIDENCE DESIGNED BY MARCEL BREUER—RADIANT HEATED with CHASE COPPER TUBE!



HERE'S WHY
you too will want Chase Copper Tube in your Radiant Heating Installations!

EASY TO BEND • LONG LIFE • LONG LENGTHS SOLDERED FITTINGS • LOW COST • LIGHT IN WEIGHT SMALL DIAMETERS

Residence in Ligonier, Penna., *is heated by coils using 6000 feet of 1" Chase Copper Tube. Outdoor piping and water supply lines use 1500 feet in sizes from ½" to 2". Architect: Marcel Breuer, New York City. Engineer: Benjamin L. Spivak, New York City. Plumbing and heating contractor: John Hall, Ligonier, Penna.*

FROM the finest of residences to economical basementless houses, there's a growing trend to radiant heating—*with Chase Copper Tube.*

Chase Copper Tube in coils, soft temper, is easily bent without special tools. It comes in 60 and 100 foot lengths—the number of connections is cut to a minimum. The joints are made easily and quickly with solder-joint fittings.

Its light weight and small diameters make it just as easily adaptable to ceiling installation as it is to concrete floor slab construction. Its high resistance to corrosion means long service life.

And it's available for immediate delivery!

Chase Brass & Copper Co., Dept. HPA 650
Waterbury 20, Conn.

Gentlemen: *Please forward your book, "Suggestions for Designing Radiant Panel Heating with Copper Tube."*

Firm_____

Name_____ Title_____

Street_____

City_____ State_____

SEND FOR FREE BOOK! "Suggestions for Designing RADIANT PANEL HEATING with Copper Tube."

Chase

the Nation's Headquarters for
BRASS & COPPER

WATERBURY 20 CONNECTICUT — SUBSIDIARY OF KENNECOTT COPPER CORPORATION

THIS IS THE CHASE NETWORK . . . *handiest way to buy brass*

ALBANY† ATLANTA BALTIMORE BOSTON CHICAGO CINCINNATI CLEVELAND DALLAS DENVER† DETROIT HOUSTON† INDIANAPOLIS KANSAS CITY, MO. LOS ANGELES MILWAUKEE MINNEAPOLIS NEWARK NEW ORLEANS NEW YORK PHILADELPHIA PITTSBURGH PROVIDENCE ROCHESTER† ST. LOUIS SAN FRANCISCO SEATTLE WATERBURY †Sales Office Only

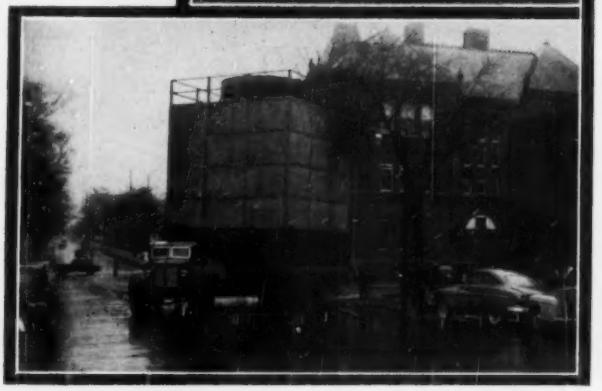
LILIE-HOFFMANN COOLING TOWERS

BUILT TO MAXIMUM STRUCTURAL STRENGTH

HERE'S PROOF!

Moving of Lilie-Hoffmann tower by Alabama Power Co. to new location 2 blocks away.

1 *Cooling Tower "Derricked" to Truck.*



2 *Moving of Tower to New Location.*

3 *Result:* **TOWER IN 100% PERFECT CONDITION**

when set up in new location.

No leaks, cracks, strains requiring repairs.

SPECIAL LILIE-HOFFMANN FEATURES:

1. Teco Split-Ring Timber Connectors used at all stress joints.
2. Bolt-through bracing connected by sidehill washers.
3. 100% working stress of members attained.

LILIE-HOFFMANN
4239 Duncan Ave., St. Louis 10, Mo.

Mail:
- ☐ 16-Page Bulletin, "Mechanical Draft Towers"
- ☐ 4-Page Bulletin, "Atmospheric Spray Towers"

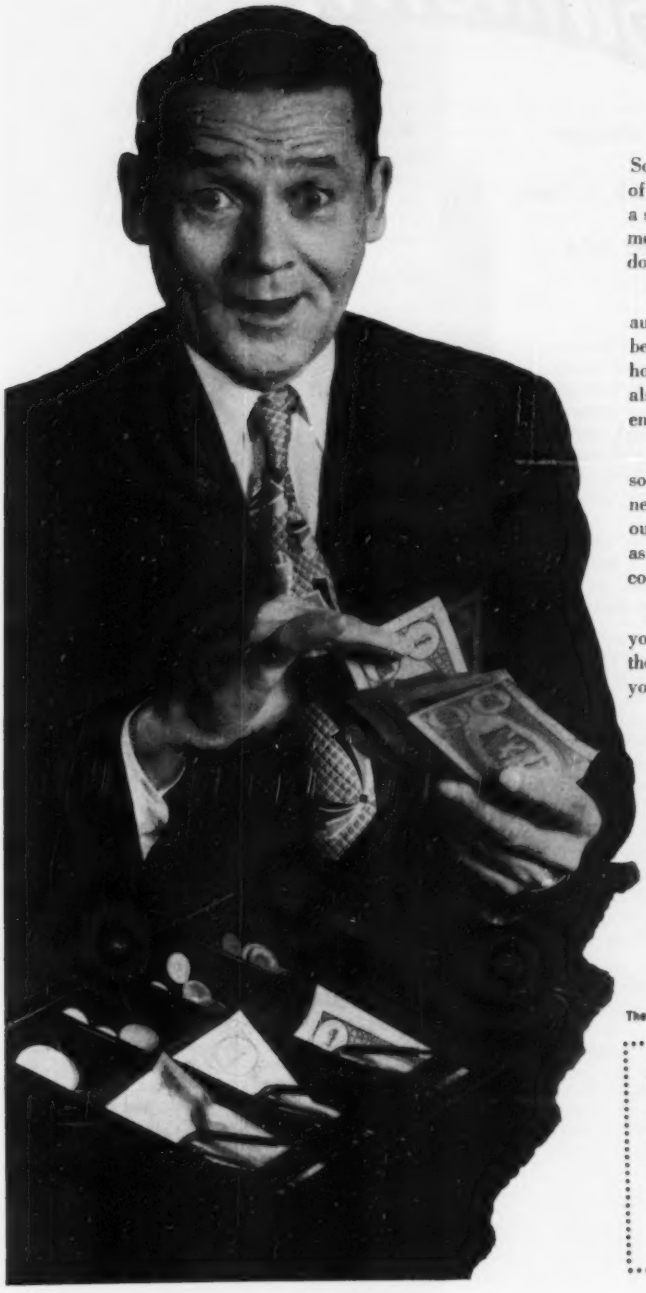
Name _____
Company _____
Street _____
City _____

LILIE-HOFFMANN COOLING TOWERS

4239 Duncan — St. Louis 10, Mo.

Lilie-Hoffmann Cooling Towers Deliver Colder Water Cheaper

So there's a different way to count profits?



Some say that profit depends on the number of dollars that flow into the till. But there's a surer way to count profits on heating equipment. It's simply knowing how many of those dollars *stay* in the till!

Take the contractor who installs Bryant automatic gas heating. He keeps more dollars because Bryant equipment requires fewer man hours for installation, fewer service calls. He also has Bryant experts to help him on his engineering problems.

Again, he saves because Bryant is a single source for most of his heating equipment needs. No endless contacts, no reams of various orders. Boilers and unit heaters, as well as furnaces, conditioners and water heaters, all come from a nearby Bryant warehouse.

No question about it, Bryant is the line if you look carefully at the profit picture. And the coupon below is a handy way to say you're interested.

Let the pup be furnace man ... and water boy, too!

bryant

AUTOMATIC HEATING

The most complete line of gas heating equipment in the nation

Bryant Heater, Dept. 154,
17825 St. Clair, Cleveland, Ohio
( ) Send me the new booklet that tells the Bryant story. ( ) Have your distributor call on me.

Name_____

Company_____

Address_____

City_____ State_____

Announcing the NEW

JENKINS SWINGTITE

with an exclusive new design that assures smooth action, positive closure, and longer life

In the new Jenkins SWINGTITE Fast-Action Bronze Gate Valve, the exclusive rolling disc and guide track design lengthens valve life and assures maximum tightness as it prevents uneven wear of seating surfaces. As the valve is opened or closed, guide rims around the seating surfaces of discs roll freely over guide tracks cast in the body, distributing wear evenly, dislodging foreign matter, and providing a polishing action for seating surfaces.

The SWINGTITE can be opened or closed instantaneously and easily with less than a quarter turn of the malleable iron lever which activates the self-adjusting ball and socket type double disc.

Wherever full, free flow is essential . . . where valve opening or closing must be instantaneous . . . you will see more and more Jenkins SWINGTITE Bronze Gate Valves setting new standards of performance and endurance. They are recommended especially for such services as laundry machinery, dish-washing equipment, gasoline and fuel oil lines, fire extinguishing steam lines in kitchens, and dispensing lines to tanks or vats.

Get all the facts on the new Jenkins SWINGTITE. Find out how much smoother-operating, how much *longer-lasting* these fast-action Bronze Gate Valves can be when *Jenkins* builds them. Send for the new folder, Form No. 196, containing full details. Jenkins Bros., 100 Park Avenue, New York 17, N.Y. Jenkins Bros., Ltd., Montreal.

Sold through leading Industrial Distributors

NO OTHER VALVE of its type HAS THIS FEATURE

Notice the guide rims (A) of the discs which rotate freely on the guide tracks (B) cast in the body, as the valve opens or closes. This roller action provides a self-cleaning and polishing effect, and also distributes the wear, since the seating position of the discs changes with each closing. Rapid, uneven wear is prevented, and continuous tight closure assured.

JENKINS VALVES

LOOK FOR THE DIAMOND MARK

SINCE 1864 TRADE JENKINS MARK

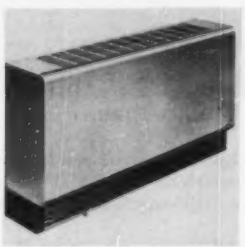
Jenkins Bros

EQUIPMENT DEVELOPMENTS...

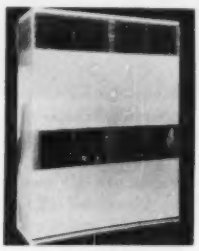
For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1950 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk, equipment and manufacturer not listed.

HPAC 4375*—CABINET UNIT FOR HEATING, COOLING—A new cabinet unit for heating and cooling stores, showrooms, offices, school rooms, corridors, lobbies, and similar commercial and public building areas has been developed by Modine Mfg. Co., Racine, Wis.

Similar in appearance to a convector, the unit is equipped with blowers which draw room air into the unit through the inlet grilles, pass it through a heating or cooling coil, and deliver it to the area served. For outside air introduction in ventilating applications, a nonfreeze coil and a plenum base with a built-in, manually operated mixing damper are available. Advantages are said to include unusual adaptability to both heating and cooling service. The unit is offered with a choice of standard or nonfreeze steam coils or a heating-cooling coil designed specifically for water. The unit is furnished in five capacities ranging from 120 to 640 sq ft, at 2 psi steam.



Heating, Cooling Unit



Air Conditioner

HPAC 4376—SELF CONTAINED CONDITIONERS—Five new models of self contained "Weathermakers," designed specifically for the air conditioning of stores, shops, restaurants, markets, offices and other places of business, range in capacities from 3 to 5, 7½, 10 and 15 hp.

An exclusive feature is the "Humitrol," designed to provide improved balance between cooling and humidity control and to speed up the dehumidifying action whenever desired. Other features include a hermetic compressor unit with dual overload motor protection, a sloping cooling coil having relatively large face area, a new "Q-T" fan, said to provide a wide range of speeds without any sacrifice in efficiency and with noise reduced to a minimum, and the "F-M" expansion valve.
Carrier Corp., Syracuse, N. Y.

HPAC 4377—LIGHTWEIGHT MAGNESIA INSULATION—"Super-Light" 85 percent magnesia insulation is now being produced by Philip Carey Mfg. Co., Cincinnati 15, Ohio. It is a mixture of not less than 85 percent basic hydrated carbonate of magnesia and 10 to 15 percent of asbestos fiber.

A new manufacturing method is said to result in a density of from 9½ to 10½ lb per cu ft. In addition to this light weight, the company states that the dimensional stability is of equal value and significance. The insulation is said to be produced in unusually accurate sizes and simplified thickness standards for commercial pipe covering are being established. This, says the manufacturer, means that the outside diameter will be made to conform with the outside diameter of standard wrought iron or steel pipe. In this way pipe insulation can be specified to build up any thickness desired by applying successive layers of standard pipe size sections, each being fitted over the preceding one.

Other advantages are said to include smooth interior and exterior surfaces, great strength-weight ratio, and a uniform, low conductivity factor.

HPAC 4378—REFRIGERATION DEHYDRATOR—"Dri-Zit", a new dehydrator for compressors from ¼ to 2 hp, utilizes silica-gel and is available in six sizes.

Made with a brazed steel body, it is tested to 2000 psi and is guaranteed not to leak or burst on any refrigeration system. All models are approximately 6 in. long and are con-

FOR YOUR CONVENIENCE [6-50]

Heating, Piping & Air Conditioning
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature

(Circle each HPAC number in which you are interested)

4375	4376	4377	4378	4379	4380	4381	4382	4383	4384
4385	4386	4387	4388	4389	4390	4391	4392	4393	4394
4395	4396	4397	4398	4399	4400	4401	4402	4403	4404
4405	4406	4407	4408	4409	4410	4411	4412	4413	4414
4415									
7670	7671	7672	7673	7674	7675	7676	7677	7678	7679
7680		7682	7683	7684		7686	7687	7688	7689
7690	7691	7692	7693	7694	7695	7696	7697	7698	7699
7700	7701	7702	7703	7704	7705	7706	7707	7708	7709
7710	7711	7712	7713	7714	7715	7716	7717	7718	7719
7720	7721	7722	7723	7724	7725	7726			

Name ..... Title.....
Company .....
Address .....
City..... Zone..... State.....

ELCO FINAL INSPECTION ASSURES DELIVERED QUALITY IN "THE SCREWS YOU LIKE TO USE"

It's aggravating, when you are using screws on the assembly line, to come across a bad one — a screw with the slot missing, bum threads or no threads at all, dubbed-off point, or a mongrel from another batch. More important, all the *good* screws should *all* be good — absolutely uniform on size, slot, finish, smoothness of threads, and point. That is the real reason why, at Elco, a group of experienced and eagle-eyed women look constantly and critically at Elco screws between the shop and the shipping department. It's a cinch for them to catch the bad ones, but it takes alertness and attention to make sure the rest are up to Elco standards. Their skill insures delivery of the uniform quality you expect in *good* screws — Elco Screws.

HAWKEYES AT WORK

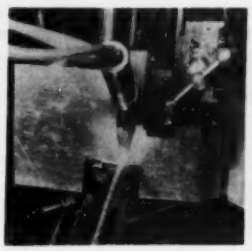
One group of Elco final inspectors, working at tables specially equipped and lighted for fast and accurate work. Elco standards of inspection are as high as Elco standards of manufacture.

ELCO TOOL & SCREW CORPORATION
1920 BROADWAY · ROCKFORD, ILLINOIS

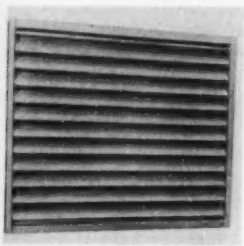
nected to lines by means of flare nuts. The inlet side is fitted with a 120 mesh screen and a diffusion plate to distribute the flow evenly. The outlet end is protected by a series of fine mesh screens.
Kerotest Mfg. Co., 2525 Liberty Ave., Pittsburgh 22.

HPAC 4379—INERT GAS-SHIELDED ARC WELDING—Spiral welded tubing of stainless steel, inconel, and plain carbon steel has been made by B & M Mfg. Co., Grand Rapids, Mich. According to Linde Air Products Co., 30 E. 42nd St., New York 17, tubing of almost any diameter and thickness can be produced by forming into a closed spiral and welding the joints with a "Heliarc" torch. The same process and equipment can be used to make tubing of brass, aluminum and magnesium. Diameters range from ¼ to 3 in. and wall thicknesses from 0.015 to 0.0625 in. or more.

Particular advantages of this process are said to be the speed and the adjustable feature that permits tube of different sizes and thickness to be welded with relatively few adjustments of the forming head and welding machine. Inert gas-shielded arc welding is said to be particularly adapted for this type of work.



Welding Stainless Steel



Louver

HPAC 4380—AIR LOUVERS—Improved construction methods are claimed by Swartwout Co., 18511 Euclid Ave., Cleveland 12, for new "Airlouver" industrial and commercial building louvers.

The frame and overlapping blades, said to be weatherproof in both open and closed positions, are fabricated under a flexible set-up designed to permit almost unlimited selection of sizes, with 74¾ in. × 48 in. as maximum dimensions for a single unit. Louvers are made in adjustable and fixed types, the former operated by any of several optional methods, and galvanized steel is the standard material used, but fabrication can be of copper, aluminum, monel, etc.

HPAC 4381—SPRAY NOZZLE WITH CLEANER—Spraying Systems Co., 3219 Randolph St., Bellwood, Ill., has introduced the ¼ J pneumatic atomizing nozzle with cleanout needle. The needle is part of the assembly and by pushing the plunger end at the rear of the nozzle, the orifice passage is cleaned.

Normal position of the cleanout needle is open under spring loading, returning to this open position when the plunger is released. The assembly is available in a variety of materials such as brass, stainless steel, and monel metal. Nozzle assemblies can be supplied in all

Speeds Installation of 45,000 Feet 1¼" Pipe with Arc Welding

By M. N. Vuchnich, *President*
The Lincoln Electric Co. of Canada, Ltd.
Leaside, Ontario, Canada

PERMANENT, leakproof construction has been made possible by arc welding the entire piping system for this ice plant arena. The installation includes 45,000 feet of 1¼" welded seam pipe imbedded in concrete. Headers and return lines for brine are 4" and 6" pipe. All joints from 6" line to ¼" nipple fittings have been arc welded to pressure tight specifications with Lincoln® "Fleetweld 5" electrodes using Lincoln "Shield-Arc" engine driven welders.

Standard 20 ft. lengths of pipe were first butt welded to form 40 ft. lengths, which in turn were butt welded to resulting 80 ft. lengths, etc. For fast, simple arc welding, pipes were supported on simple roller rests and turned by hand. With this method, over 2400 butt joints were *finished in an average time of two minutes per joint.* After pipe lengths were laid down and spaced 4½" apart, "U" bends were butt welded in position. The ends of the pipe were raised for welding underneath the bends.

Fig. 1. Arc Welding "U" bends to 1¼" pipe with Lincoln 200 ampere "Shield-Arc" engine driven arc welder. Joints are pressure-tested before encasing in concrete.

The heavier 4" and 6" pipe for headers and return lines to the engine room were beveled 60 degrees included angle and welded with two passes of 5/32" "Fleetweld 5" to produce pressure tight joints.

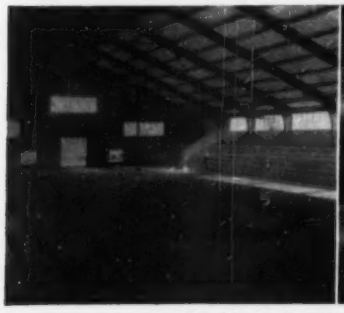


Fig. 2. Floor area of 83' x 200' has 45,000 feet (2400 butt joints) of arc welded 1¼" pipe.

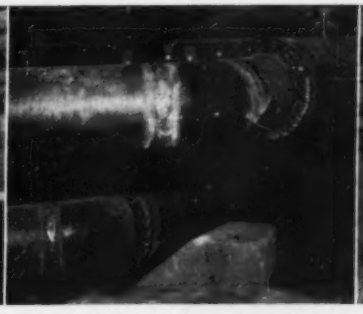


Fig. 3. Typical welded connection of 4" pipe to 6" pipe on headers and return lines with multiple passes of "Fleetweld 5".

Fig. 4. All welded piping system for ice plant using 4" and 6" pipe with Tube-Turn welding fittings for short bends.

GET THE FACTS

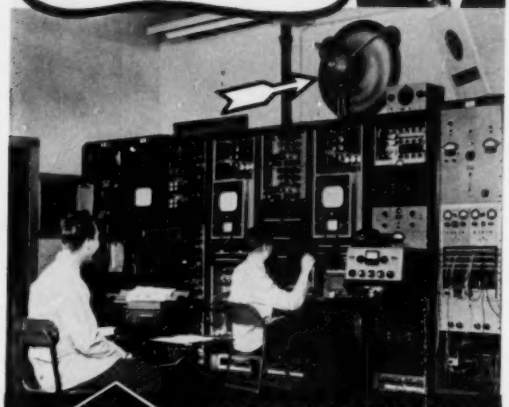
Send for Bulletin 403, Lincoln Welding Guide. Write
THE LINCOLN ELECTRIC COMPANY
Dept. 283, Cleveland 1, Ohio

Sales Offices and Field Service Shops in All Principal Cities

LINCOLN

"Exhausts heat from TV transmitters"

Howard Lepple, Chief Engineer, Television Station WLW-D Dayton, Ohio



ILG VENTILATION

"... lowers inside temperature 15° in summer time."

Mr. Lepple says, "Before installing our ILG Self-Cooled Motor Propeller Fan, the heat from our transmitter caused the inside temperature to rise approximately 15° above that outside in the summer. We are now able to hold it very close to equal. The fan is just completing its first year of trouble-free service." Every building, old or new, needs a positive supply of fresh, clean air. With building at near record highs, now is the time to cash-in on this demand. Call your nearby ILG branch office (consult classified directory) or send coupon below.

The ILG Self-Cooled Motor Propeller Fan ... quiet ... powerful ... long-lived. Patented self-cooled motor. Exclusive Type "Q" fan wheel. The 2 to 1 favorite of engineers and contractors.

FREE! Helpful 32-Page Guide

"HOW TO PLAN YOUR VENTILATING SYSTEM"

ILG ELECTRIC VENTILATING CO.
2841 North Crawford Avenue, Chicago 41, Illinois
Offices in more than 40 Principal Cities

☐ Please send me a copy of your FREE BOOKLET "How to Plan Your Ventilating System."

Company Name_____

Executive's Name_____ Title_____

Address_____ Zone_____

City_____ State_____

standard company pneumatic atomizing nozzle set-ups designed for internal or external mixing of air and liquid to produce round, multiple round, or flat sprays.

HPAC 4382—ROTARY WORK ALIGNER**—A new rotary work aligner for handling materials requiring rotation in manufacture, assembly, welding or repair is designed to insure alignment of two or more pieces of work and eliminate expensive set ups for miscellaneous jobs. It may be used for either centered or uncentered work and on any circular material from ¼ to 24 in. diameter.

Two or more aligners may be used in handling long sections. At present, four models are being produced in bed lengths from 5 ft 10 in. to 11 ft 6 in. with a load capacity of 1500 lb.

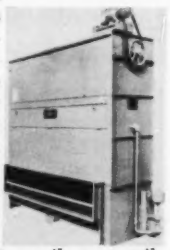
Johnson Machine Works, 619 Menomonie St., Eau Claire, Wis.

HPAC 4383—ROOM AIR CONDITIONER—A new, improved room air conditioner has been developed by Airtemp Div., Chrysler Corp., Dayton 1.

Measuring 13 in. in height and 27 in. in width, the ½ hp model is rated at up to 6000 Btu per hr. A larger, ¾ hp model, is available with a capacity of 8500 Btu per hr. Both models are designed for installation in practically any type of window.

Piping connections are not required and features are said to include a hermetically sealed compressor, a four-way adjustable air grille, an outside air intake, and a replaceable air filter.

HPAC 4384—EVAPORATIVE CONDENSER—A new "Aeropass" evaporative type refrigerant condenser, designated as the 5800 series, is designed especially for use where "Freon" is the refrigerant and for air conditioning and industrial refrigerating applications. The series consists of five standard units ranging in capacity from 10 to 50 tons at 105 F condensing temperature and 74 F atmospheric wet bulb temperature.



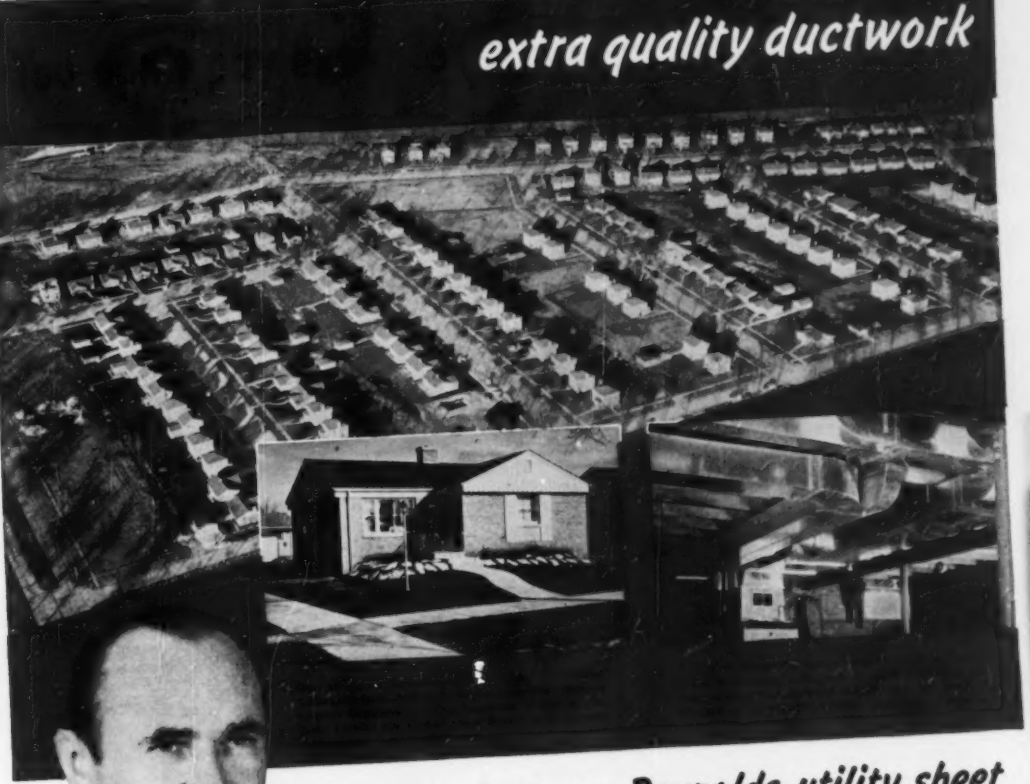
Casing, fan and eliminator construction is galvanized steel and either copper tube with copper fin or hot galvanized steel tube and fin condensing coils are available.

Niagara Blower Co., 405 Lexington Ave., New York 17.

HPAC 4385—MOTOR STARTER—The new a-c magnetic, nonreversing "Life-Linestarter" is offered by Westinghouse Electric Corp., P. O. Box 2099, Pittsburgh 30.

Designed for either across-the-line starting of squirrel cage induction motors, or as a primary switch for wound rotor induction motors it has only one moving part, a "see-saw" lever balanced on a knife-edge bearing or center fulcrum. The "De-ion" breaker is said to extinguish arcs in a half cycle or less. Available in NEMA sizes 0 through 4, the starter can be applied to all integral horsepower motors up to 100 hp.

extra quality ductwork



Walter Baltis has built hundreds of homes in the Chicago area—is building more than 300 this year. Sharp man with a pencil, Baltis finds aluminum for ductwork economical, says, "Aluminum ducts are very satisfactory—a quality feature of our homes."

You just use Reynolds utility sheet ... to get Aluminum's Big Benefits!

ARE wrong ideas robbing you of the extra profit in Reynolds Aluminum for ductwork? Then look at the facts. You divide aluminum's price per pound by three because, thickness for thickness, lighter aluminum has three times the metal surface per pound. You can use all your present equipment, including Pittsburgh lockseamers. Hand work is faster because aluminum is easier to fabricate. Actually, one man can handle duct installations without fatigue. And you can save time in completing contracts.

Your work wins an "extra quality" reputation when you use Reynolds Aluminum utility sheet. Customers like its sound deadening and neat appearance features. There's no threat of rust, so the cost of painting is eliminated. Aluminum's smooth surface assures maximum air delivery. Insulating properties prevent excessive temperature loss. Of course, it's approved for F.H.A. financing—see Section 9, Bulletin UM-5, March 24, 1950.

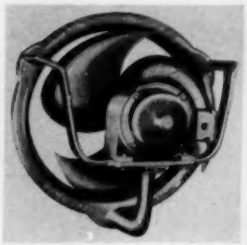
That's why progressive sheet metal men are turning to aluminum—a step forward in the sheet metal trade. For your next job order Reynolds Aluminum utility sheet. Available from your local Reynolds Distributor or call the nearby Reynolds Office. Both are listed under "Aluminum" in classified directories. **Send for the helpful 32 page book, "Aluminum in Heating, Ventilating and Air Conditioning." Reynolds Metals Company, 2566 South Third Street, Louisville 1, Kentucky.**

REYNOLDS METALS

REYNOLDS *Lifetime* ALUMINUM

HPAC 4386—EXPLOSION-PROOF PROPELLER FAN—A new series of type X explosionproof propeller fans for class I, group D hazardous locations, combining the performance features of the company's type Q propeller fan and the ball bearing explosionproof motor, has been developed by Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago.

The aluminum propeller fan wheel is dynamically balanced and the cast aluminum fan frame has a streamlined air inlet. Eight models are available with single phase and three phase motors. All sizes are suitable for horizontal or vertical operation.



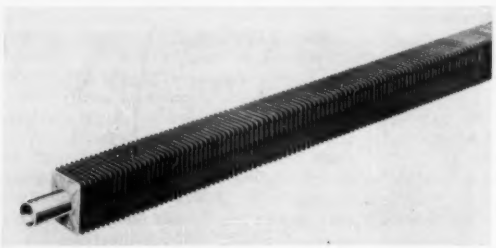
Explosionproof Fan

Turbidimeter

HPAC 4387—RECORDING TURBIDIMETER—A new photoelectric instrument which automatically measures and records the amount of suspended particles in a liquid is designed to monitor and control processes in water treatment plants or wherever turbidity is a significant condition of the process.

The device operates on the principle that turbidity of a liquid varies in direct proportion to the ratio of scattered light to transmitted light through the liquid. Since it is a ratio measuring instrument, results are not subject to variations in color of the liquids under test or variations in voltage supplied to the light source. Equipment consists of a cast bronze sampling chamber and either a strip or circular chart recorder.
General Electric Co., Schenectady 5, N. Y.

HPAC 4388—FINNED WALL RADIATION—Fedders-Quigan Corp., Buffalo 7, N. Y., has developed new wall radiation of the finned tube type for industrial, commercial, institutional and similar applications.



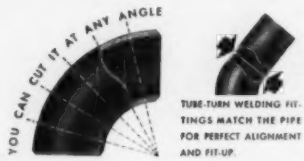
High heat output is said to be achieved by expanding cold drawn seamless steel tubing into collared, die formed steel fins. The fins are designed to create a turbulent scrubbing action of air flow and to provide unusual fin strength.

Enclosures are available in three styles; type EM with a one piece expanded steel mesh top and front, type FT

HOW TO SIMPLIFY ODD-ANGLE PIPING

The ease with which pipe can be installed at odd angles for compactness is an important reason for the widespread preference for Tube-Turn Welding Fittings.

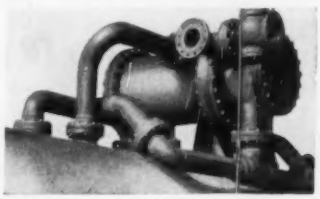
For example, one of the country's leading consulting engineers (name upon request) states: "We employ a great number of experienced welders in all parts of the country. They all prefer Tube-Turn Welding Fittings because many of the fittings we use must be cut to odd angles. When lining up the fittings, cutting them and placing them into the line, our welders say they are more



sure of accurate alignment and fit-up with Tube-Turn Welding Fittings than with any other make."

There's good sound reason behind this preference. Tube-Turn Welding Elbows and Returns are formed to give you *true circularity . . . accurate curvatures and center-to-face dimensions . . .* and *absolute uniformity of wall thickness. Hence, you can cut a Tube-Turn Welding Elbow or Return to any odd angle required and it will line up perfectly with the pipe.*

Tube-Turn Welding Fittings are available in a *complete range of sizes, shapes and materials.* For speed, simplicity and versatility in piping installations, be sure you get *genuine* Tube-Turn Welding Fittings.



Tube-Turn Welding Fittings simplify the fabrication of intricate piping system designs such as the installation shown above. Their true circularity and uniform wall thickness permit cutting and welding them at any odd angle.

FREE BOOKLET

Write for your free copy of "Allowable Working Pressures." It contains valuable information on Power Piping, Oil Piping, District Heating Piping, Gas and Air Piping and Refrigeration Piping.

"Be Sure You See The Double tt"

TUBE TURNS, INC.

LOUISVILLE 1, KENTUCKY

In all the world there's only one TUBE-TURN Welding Fitting as shown by this trade mark... the right mark for every need in welding fittings and flanges.

TUBE-TURN

Your nearby TUBE TURNS distributor can serve you right from stock. Call him for prompt delivery.

TUBE TURNS, INC., LOUISVILLE 1, KENTUCKY DISTRIBUTORS IN ALL PRINCIPAL CITIES

DISTRICT OFFICES: NEW YORK • PHILADELPHIA • PITTSBURGH • CHICAGO • HOUSTON • TULSA • SAN FRANCISCO • LOS ANGELES

In Canada . . . Tube Turns of Canada Limited, Chatham, Ontario

Mueller Climatrol Type 20 Gas-Fired Boiler. 43 sizes — A.G.A. input ratings from 189,000 to 3,780,000 Btu per hour.
Mueller Climatrol Type 10 Gas-Fired Boiler. 9 sizes— A.G.A. input ratings from 54,000 to 378,000 Btu per hour.
Mueller Climatrol Type 11 Gas-Fired Boiler. Same as type 10 except with controls exposed.

Mueller Climatrol Fuel-thrifty Gas Boilers

give you three advantages that sell your gas-boiler jobs

Whether you are selling in a competitive market or on jobs where price is not an important factor, you enjoy the confidence of your buyers when you specify Mueller Climatrol boilers. This is due to Mueller's national reputation for quality products.

Consider these advantages in handling Mueller Climatrol boilers:

- ✓ Complete line of sizes and models for every residential or commercial heating or hot water application. Units can be installed for steam, hot water or vapor systems.
- ✓ Attractive, compact units with designed selling features. Mueller boilers are easy to install and service, provide highly efficient, economical and dependable operation.
- ✓ Types 10 and 11 boilers are A. G. A. approved for L-P gases as well as natural, mixed, and manufactured gases. All conform to A. S. M. E. code for low pressure boilers.

L. J. Mueller Furnace Co., 2127 W. Oklahoma Avenue, Milwaukee 7, Wisconsin.

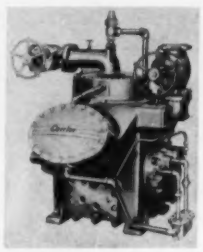
93rd Anniversary — MUELLER Climatrol REG. U. S. PAT. OFF. E-36

with a solid front and a grille in the flat top, and type ST with a solid front and a grille in the sloping top. The radiation is available in lengths from 2 to 12 ft in 6 in. increments, and 38 and 50 fins per foot are available on the 1¼ in. pipe and 24 fins per ft on the 2 in. pipe. Either threaded ends or plain chamfered ends for welding may be ordered.

HPAC 4389 — REFRIGERATION COMPRESSORS — Two new models of large reciprocating compressors, from 100 to 150 horsepower in single units and designed to operate with a variety of refrigerants, have been developed by Carrier Corp., Syracuse, N. Y.

They can be either direct or belt driven, powered by motor, gas or diesel engine, or steam turbine with gear, and can be adapted for operation as dual units from a single motor with a double shaft. The high partial load efficiency of these new machines, says the company, is due to the design of cylinder unloading which also provides unloaded starting so that normal torque motors may be used. The compressors may be used with "Freon 12," "Freon 22," or ammonia.

The model 5J40, a four cylinder machine, using "Freon 12," has a nominal cooling capacity of 100 tons for air conditioning. The model 5J60, a six cylinder compressor, using "Freon 12," has a capacity of 150 tons for air conditioning.



Refrigeration Compressor

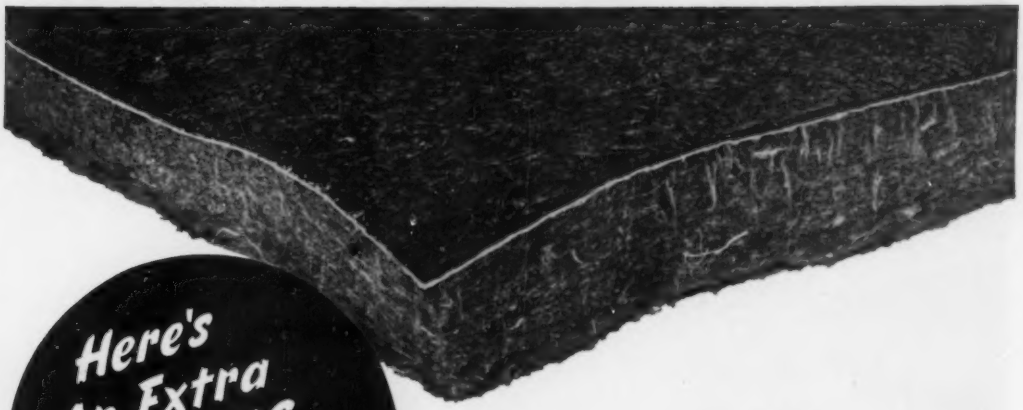
Humidity Controller

HPAC 4390—HUMIDITY CONTROLLER—A new instrument which records and automatically controls humidity is available from Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. The device is designed to regulate automatically the wet bulb depression for which it is set, regardless of any fluctuations in the dry bulb temperature.

Two pens operate on a circular 10-in. chart, simultaneously recording the dry bulb temperature and the wet bulb depression. The flow of the humidifying agent, moisture, steam or oil fog, is regulated by a valve which is operated by the control instrument.

It is recommended for all process industries and utilities, such as textile, chemical, tobacco, food, natural gas and many others which require precise humidity control during the processing of a product or material. For applications involving gas, such as the saturation of natural gas in the main, bars can be clamped on the case of the instrument, to make it gas tight.

HPAC 4391—RAILWAY CAR POWER PLANT—General Electric Co., Schenectady, N. Y., recently unveiled its More Power To America Special, a 10 car train containing a series of related exhibits on the production,



Here's An Extra SELLING "EDGE" for You!

Grant Wilson DUX-SULATION

(ASBESTOS-PROTECTED)

FOR MAXIMUM TEMPERATURE CONTROL BETWEEN SOURCE AND REGISTER OR GRILLE

You give yourself an extra advantage over competition when you recommend Dux-Sulation for warm air heating, air conditioning or ventilating systems. Why? Because you're selling *a lot more* than a conventional duct job. You're selling a system that, once balanced, *stays* balanced —an installation that eliminates "call backs," that permits using the smallest possible heating or cooling unit . . . an installation that's quiet!

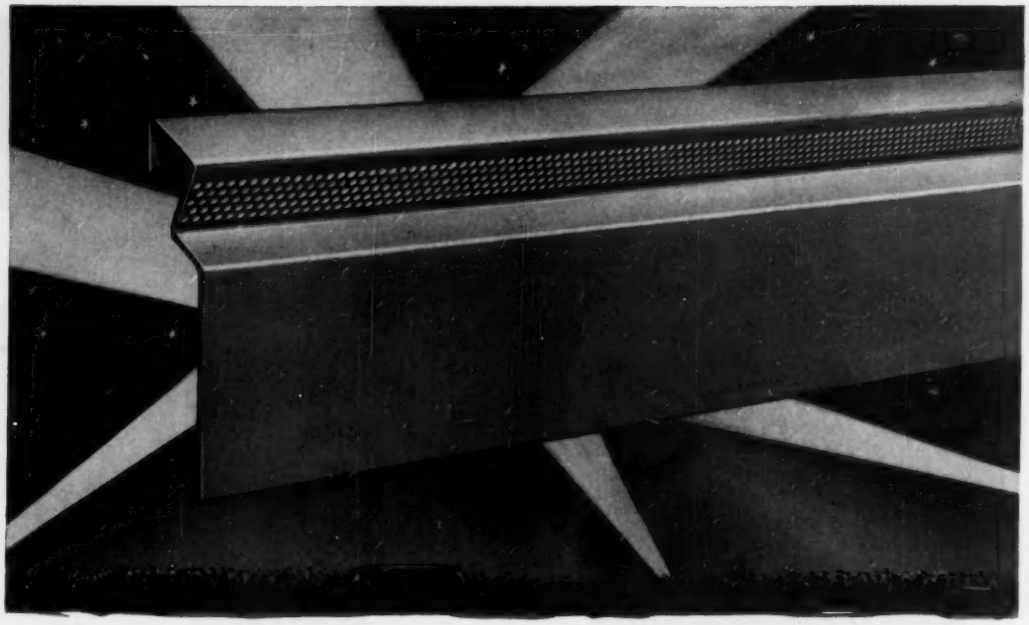
The building owner gets his Dux-Sulation investment back many times over in fuel savings alone; its efficiency, economy and extra comfort build priceless good will for Contractor, Engineer and Architect alike. No matter how you look at it, selling Dux-Sulation is simply *good business* for you; it helps land business and *it keeps right on "selling" for you* long after the job is completed.

Dux-Sulation is available in either ½" or 1" thickness in rolls 36" wide containing 100 square feet—convenient to stock and handle. Special tape and glue (included) make installation quick and simple. Inspect Dux-Sulation yourself; write Grant Wilson, Inc., 141 W. Jackson Blvd., Chicago 4, Ill., for FREE sample kit No. 2-H 536.

Send for this FREE sample today . . .

Grant Wilson inc.

ASBESTOS and INSULATING MATERIALS



New Beauty *for Vulcan Baseboard*

MORE EYE APPEAL . . . MORE SALES APPEAL IN VULCAN'S NEW TYPE L FRONT COVER

Designed Exclusively for Vulcan by famous industrial designers, and RAYMOND LOEWY ASSOCIATES.

Here is *MAGIC* in Baseboard Cover design. The source of heat becomes invisible because Type L blends so completely with the room decoration — yet the smooth, absolute heating comfort of Vulcan fin-tube radiation is just as effective as ever.

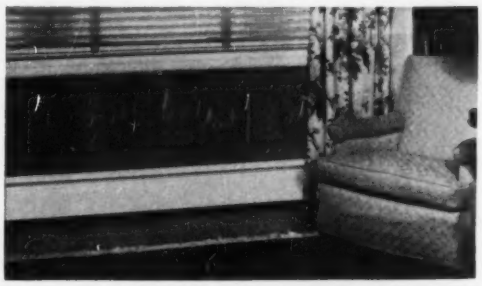
Every architect, heating engineer, and homeowner who was privileged to preview Vulcan Type L gave it instant approval — a sure sign of its sales appeal and popularity.

Made for Semi-recessed and Non-recessed installations, Type L has complete accessories and is available in any desired length in increments of 1".

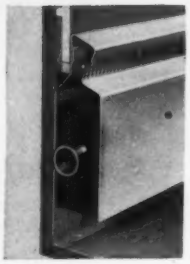
Remember Vulcan fin-tube radiation is easy to install . . . requires few fittings or supports, comes cut to length, ends threaded or chamfered.

For Smooth Heating Comfort, for Beauty of installation, Vulcan has no equal.

Made in Canada, under trade name of Heal Radiation, by the Vapor Car Heating Co. of Montreal.



You have to look *twice* to see it . . . experience its smooth heat but *once* to know why Vulcan is specified by leading architects and heating engineers.



Cross section Type L Cover, Semi-recessed. (PATENTED)

THE VULCAN RADIATOR CO.
26 FRANCIS AVE. HARTFORD 6, CONN.

distribution, and industrial utilization of electric power. It will visit approximately 105 key industrial centers during 1950 and 1951.

Power for the heating, lighting, and air conditioning of the train, as well as for the exhibits on board, is furnished by new GE diesel driven, under car power plants. Rated at 30 kw, one of these units is mounted beneath each of the streamliner's 10 cars, and four additional units are installed in a section of the baggage-dormitory car to supply additional power required by some of the exhibits. Chief advantage of this type of equipment is said to be the elimination of the load on the locomotive produced by axle driven generators. Engine water is cooled by a separately mounted radiator which is blown by a motor driven, propeller type fan. Another major advantage of the unit is said to be the fact that it makes available a large supply of potential heat in both the engine jacket water and the engine exhaust, in addition to supplying about 20 kw of electric heat.

HPAC 4392—FLARELESS TUBE FITTING**—Aircraft Fitting Co., 1400 E. 30 St., Cleveland 14, has introduced a new flareless tube fitting of improved design said to eliminate tube gouging and to limit tube distortion.

The gripping action of the fitting sleeve is said to form a positive leakproof seal and make the fitting especially suitable for copper, steel, stainless steel, and aluminum tubing. It is available in all standard shapes and sizes for tubing up to and including 1 in. OD. Many special combination shapes and sizes up to and including 2 in. can be furnished. All shapes (elbows, tees, crosses, etc.) are machined from forgings; all other parts are machined from bar stock.

HPAC 4393—HYDRAULIC RELIEF VALVE**—A new cartridge type of hydraulic relief valve is available for pressure settings ranging from 100 to 5000 psi and is designed to open and close within a 7 percent differential.

Constant repeat accuracy, says the manufacturer, is assured by the "in balance" design of the valve which is said to be free from squeal and chatter. The entire operating mechanism is contained in a cartridge which is so designed that it may be replaced without breaking the line. Pressure adjustments are made by means of an adjustment screw.

Hydraulics Div., Pantex Mfg. Corp., Pawtucket, R. I.

HPAC 4394—PACKAGED AIR CONDITIONING UNIT—The new five hp, model 520 unit conditioner of Frick Co., Waynesboro, Pa., features a compressor-motor assembly of the hermetic type.

Between the ½ hp centrifugal fan and the four rows of the finned cooling coils is an open space for the insertion of heating coils. Below the finned coils is a coil of bare copper pipe used for precooling the air and superheating the suction gas. Immediately below this is the air filter, made with several layers of oil coated wire mesh. Cooling water jackets, on both sides of the motor windings, are also used to remove compressor heat and

semi-knife-edge bearing reduces frictional wear

This is Ward Leonard's new Bulletin 110 Midget Relay for long, trouble-free service, particularly in equipments subject to vibration.

Exceptionally good vibration characteristics are due to proper proportioning of contact masses and springing combined with heavy pressures on both normally open and normally closed contacts.

Higher contact ratings than most midgets. Available up to 3-pole, double throw. Contact finger leads are insulated with the new, impregnated glass-fiber tubing.

Write for Bulletin 110. Ward Leonard Electric Co., 24 South Street, Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

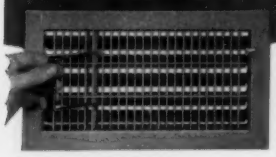
WARD LEONARD ELECTRIC COMPANY

Result-Engineered Controls

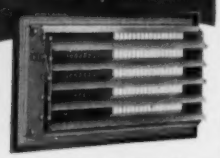
RESISTORS • RHEOSTATS • RELAYS • CONTROL DEVICES

You can get
DIRECTED AIR FLOW
at any angle with

INDEPENDENT
"Fabrikated"
REG. U. S. PAT. OFFICE
AIR CONDITIONING REGISTERS

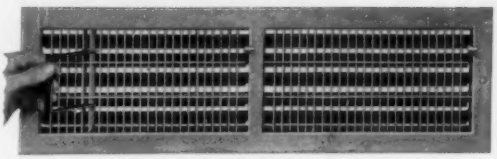


321-A HMV



Rear View Showing "HMV" Valves

Every grille bar adjustable individually—before or after installation



321-A HMV Tandem

Any direction of air flow—right, left, up, down and any combination—is easily obtained with "Fabrikated" Style No. 321-A HMV air conditioning registers, for residence or commercial installations, on sidewalls or ceiling. The face bars are adjustable to right or left; valves on the back are adjustable to direct the air flow up or down; valves may also be fully closed, and are connected to open or close in unison.

The angles of deflection and the combinations to be had are practically unlimited. Adjustments for directed air flow may be made before or after installation. Grille bars are held firmly in place and will not vibrate or rattle.

"Fabrikated" registers are available in sizes from 8 x 4″ to 48 x 24″, including tandem style. Special sizes can be made without special die set-up charges.

Write for Catalog No. 48.

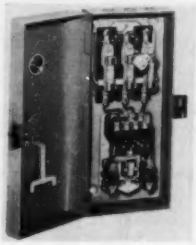
Always Leading—Always Progressing

THE INDEPENDENT REGISTER CO.
3747 E. 93rd STREET · CLEVELAND, OHIO

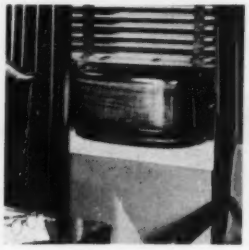
the shell of the condenser is insulated, practically all of the heat from the discharge gas being carried away by the cooling water. All interior walls and removable panels are insulated with ½ in. rockwool.

HPAC 4395—MOTOR STARTERS—Bulletin 4120 A. C. combination magnetic starters with disconnect switches—fusible and nonfusible type—are motor starters for industrial and commercial use where a magnetic full voltage starter coupled with disconnect means at the starter location is preferred over separately mounted components.

Starters are said to feature front operation, maximum safety, simplified installation, thermal overload protection, high arc interruption capacity, provision for padlocking in "On" and "Off" position and interlock protection in "On" position. Units are available in four standard sizes up to 50 hp, 3 phase, 550 volt, 60 cycles. Ward Leonard Electric Co., Mount Vernon, N. Y.



Motor Starter



Room Cooler

HPAC 4396—ROOM COOLERS—Three new models of room air conditioners, expanding its line to six units in varying types and capacities, and featuring modernistic styling, improved efficiency and a new color program, are offered by Carrier Corp., Syracuse, N. Y.

Window units, increased from two to three models, are finished in a brown and walnut blend. Consoles, increased from one to three models, have a standard two-tone brown finish. At customer request, under a new program, units can be refinished by distributors and dealers in a wide range of colors from pastels to heavy hues, in finishes of flat, satin or enamel to match interior decoration.

All units have hermetic type compressors, adjustable outlet louvers, replaceable air filters and acoustically treated cabinets. Window units have simplified controls which provide for operation on a complete cycle of cooling, dehumidification, air cleaning and circulation; for ventilation only; or for a quick exhaust of smoke or other room odors. Consoles have the same controls plus a special two speed fan control switch.

HPAC 4397—FLEXIBLE METAL HOSE—A new angle type bronze braided metal hose vibration eliminator has been added to the refrigeration line of Techniflex Corp., Port Jervis, N. Y.

Manufactured as a unit, it is designed to reduce labor and material costs on installations where compressor manufacturers recommend the use of two vibration eliminators at right angles for absorbing vibration and noise. It is available in diameter sizes of 1 in. and up.

You can be sure that a manufacturer who devotes all his efforts on the production of one type of product alone will give you the best that he is capable of offering you. Because he concentrates his skill and talents—research and experiments—capital and labor investment on the one purpose, he puts all his faith in the success of that pursuit. He faces a competitive market, as it were, with one "shot" of ammunition—and he knows "it better be good" if he expects to survive. He must depend upon that hope and confidence in his enterprise that his single effort will be rewarded by your acceptance of his product.

Tubing is the only product of Wolverine Tube Division. It has been our product for over a quarter century.

While never overlooking the possibility of making our product better, we are also giving much attention to ways and means of bringing you greater benefits in the use of tubing through Customers' Engineering Service.

Wolverine tube is produced under one quality-control from ore to finished product. You can buy this non-ferrous seamless tube with absolute confidence.

Send for literature about the application of tube in your particular field.

WOLVERINE TUBE DIVISION

Calumet & Hecla Consolidated Copper Company, Inc.

Manufacturers of seamless, non-ferrous tubing

1419 Central Avenue • Detroit 9, Michigan

Plants at Detroit, Mich. and Decatur, Ala.

Stocks Available at All Wolverine Mill Depots:
DETROIT, MICH. • DECATUR, ALA. • HOUSTON, TEXAS
LOS ANGELES, CALIF. • LONG ISLAND CITY, N. Y.

Sales Offices in Principal Cities

Save water! Save space! Save installation time and money! Save operating costs! Yes, install Governair and *save from $50 to $200 for each ton* of the completely packaged Governair unit designed to fit your needs!

Experience proves Governair can save you up to $5,000 on a 50-ton Governair unit that gives greater dependability and more "engineered efficiency" than ever before!

If you want the best — if you want the most economical and reliable air-conditioning unit on the market . . . CHOOSE GOVERNAIR and SAVE!

AIR CONDITIONERS

EVAPORATIVE CONDENSERS

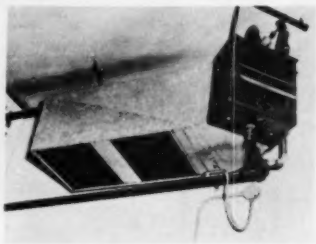
BLAST COILS FOR HEATING & COOLING

UNIT COOLERS

GOVERNAIR CORPORATION • 513 N. BLACKWELDER • OKLA. CITY

HPAC 4398—UNIT HEATER AIR FILTERS—A filter arrangement for handling air passing through unit heaters has been developed by Research Products Corp., Madison 10, Wis. The primary purpose is the cleaning of air as it is recirculated in the heated area; however, a secondary feature is the passing of only filtered air through the heater itself. This is said to result in higher efficiency, less wear of parts, and a reduction in maintenance and cleaning expense.

As shown in the accompanying illustration, the air filters are mounted in a box or plenum which is attached to the inlet side of the unit heater.


Air Filter Arrangement for Unit Heaters

Fastening Tool

HPAC 4399—POWDER-ACTUATED FASTENING TOOL—The new "Drive-It" series 300 fastening tool of Powder Power Tool Corp., 0719 S. Woods St., Portland 1, Ore., utilizes a small powder charge to drive a hardened steel drive pin or stud into steel, concrete, and similar materials.

One of the major features of the new model is "controlled power" whereby the penetration of the fastening pin can be varied for materials of different densities. According to the company, this eliminates the need for using three or four different powder charges. Another feature is the introduction of flangeless drive pins which are said to be relatively inexpensive and to eliminate the necessity for digging the sheared flange from the barrel. Other features include "twist of the wrist" firing (no pushing or hitting), a built-in safety pad, and an automatic extension barrel.

HPAC 4400—SMALL PACKAGED BOILER—The "National Packet", an automatic heating unit which includes a steel boiler, oil burner, tankless heater for hot water supply, controls for steam or hot water heating, and other regulating devices, is being manufactured by National Radiator Co., Johnstown, Pa.

The unit is recommended for use in stores, individual apartments, roadside diners, motels, and similar locations where there is a small-to-medium heating load.

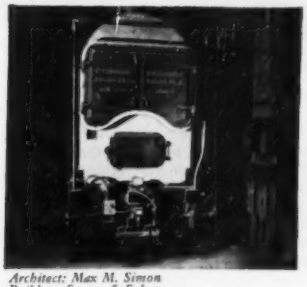
The vertical steel boiler utilizes horizontal flue travel and equipment for hot water use includes an oil burner, expansion tank and air eliminator, copper coil tankless heater of 180 gal per hr capacity, a new modulating control system known as "Raytrol", a circulator, a stack switch, an altitude gauge and thermometer, a draft regulator, an ASME relief valve, and a room thermostat.

FITZGIBBONS

heats the big jobs!

LINWOOD PARK APARTMENTS, FORT LEE

One of the largest housing projects in New Jersey



Architect: Max M. Simon
Builders: Sarner & Solow
Heating Contractor: Paramount Heating and Plumbing Co.

TWENTY-SIX FITZGIBBONS STEEL BOILERS will be used to provide warmth and comfort for the 2,486 families that will occupy this attractive group of garden apartments, ideally situated just across the Hudson River adjacent to the northern part of New York City. Another of the big housing developments whose mere size indicates most careful discrimination in equipment selection.

The best buildings deserve "the best in steel boiler heat"—The Fitzgibbons Boiler.

MEMBER SBI

Reg. U.S. Pat. Off.

MOST ECONOMICAL IN STEEL THE FITZGIBBONS BOILER

Reg. U.S. Pat. Off.

Fitzgibbons Boiler Company, Inc.
101 PARK AVENUE, NEW YORK 17, N. Y.

Send me the "D" TYPE Boiler Catalog.

Name: .....

Address: .....

City: ..... State: .....

HPAC 4401—ROOM AIR CONDITIONERS—Relatively large cooling capacities, quiet operation, and small, beautiful cabinets are said to be the salient features of the six models comprising the new line of room air conditioning units offered by Remington Air Conditioning Div., Remington Corp., Cortland, N. Y.

The console types include 1 hp and 1½ hp water cooled units, together with 1¼ hp and 1¾ hp air cooled conditioners. The two window units are of ½ hp and ¾ hp size. All units are offered with hermetic refrigeration systems for the more prevalent electrical characteristics. Open compressors, however, have been retained in the console models for 115 and 230 volt d-c current and for 50 cycle application.

Room Cooler

Humidity, Temperature Indicator

HPAC 4402—TEMPERATURE, HUMIDITY INDICATOR—Friez Instrument Div., Bendix Aviation Corp., Taylor Ave., Towson, Baltimore 4, is offering a new direct reading humidity and temperature indicator called the "Hygrodial".

It is a direct reading instrument with the humidity scale graduated into 10 equal divisions from 0 to 100 percent over an area of 2½ in. The thermometer is a red liquid filled, lens front type and is said to be accurate to within 1 deg at 70 F. Both sets of numerals are satin-finished aluminum on an etched black background. Slots on each side and the bottom are used to provide ventilation for quick sensing by the motivating element.

The humidity sensing element is composed of fine blond human hair. According to the manufacturer, blond hair is unusually sensitive to changes in the atmospheric moisture content.

HPAC 4403—COOLING FANS—A complete line of portable cooling fans for industrial, commercial, and residential applications has been announced by Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago 41. The fans range from the "Ilgdualaire" bracket base, double purpose unit of 2500-3600 cfm capacity to large pedestal base fans of 6950 to 8400 cfm capacity.

For commercial and industrial use, there are large capacity "Ilgstreamaire" fans for wall or ceiling installation, "man-cooling" fans, and "Ilgwind" fans for rapid air change in hot spots and for night air cooling. Exclusive features include the type Q fan wheel, designed to move a large volume of air quietly.

Diagram showing new nozzleless water distribution system

Quiet...

Binks Type E Induced Draft Cooling Tower
30 Standard Sizes

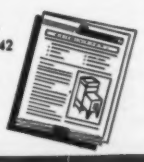
a NEW type cooling tower

for use with "packaged" water-cooled air conditioning and refrigeration systems

A new type of water distribution system eliminates the use of spray nozzles in Binks Type E blower-type cooling towers. Distinguished by extremely quiet operation and high efficiency, these towers are ideal for use with "packaged," water-cooled air conditioning and refrigeration condensing units, such as are installed in small businesses and residences. Installations may be either outdoors or indoors.

- All galvanized steel construction
- Capacities up to 36 tons
- Attractively priced
- Easily installed
- No internal piping
- Low pumping head
- Shipped assembled
- Low operating cost

Write today for Binks Bulletin No. 42 which includes complete data on all 30 Type E cooling towers.



THERE'S A BINKS SPRAY NOZZLE FOR EVERY SPRAY JOB

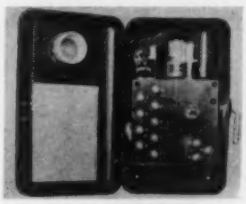
Binks MANUFACTURING COMPANY

REPRESENTATIVES IN ALL PRINCIPAL CITIES ■ 3118-38 CARROLL AVENUE, CHICAGO, ILL.

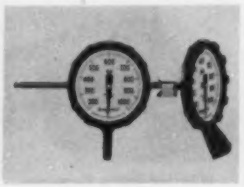
HPAC 4404—PHOTOELECTRIC CONTROL—The new series 20 general purpose photelectric control of Photoswitch, Inc:, 77 Broadway, Cambridge 42, Mass., is offered with the phototube integral with the control or located in a separate housing for applications where space is limited.

It is supplied with forward and reverse circuits so that tube replacement is indicated by either an energized or de-energized relay, and it is designed to operate on 115 and 230 volt supply. A "tamperproof" sensitivity adjustment is said to provide positive operation over varying distances between the phototube and light source.

The control is recommended for motor and valve control, short range signal systems, machinery safeguards, and automatic control for hundreds of specialized industrial processes.



Photoelectric Control

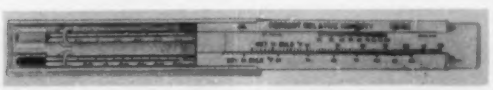


Dial Thermometer

HPAC 4405—DIAL THERMOMETER—A new "Tempoint" dial thermometer for indicating temperatures from 200 to 1000 F has a 3 in. diameter body and a stainless steel stem.

Exceptional readability is claimed for the instrument due to the long V-shaped pointer which is colored bright red, and its relatively large nonglare scale with correspondingly large numerals. The temperature indicating element is a bimetal coil and accuracy is said to be 1 percent of range at any point of indication.
Bacharach Industrial Instrument Co., 7000 Bennett St., Pittsburgh 8.

HPAC 4406—RELATIVE HUMIDITY INDICATOR—A pocket instrument that shows relative humidity by the wet and dry bulb method has been developed by Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark 5, N. J. Known as the "Tag Humidicator" model 8704, it can be used either in the hand or mounted on a wall.



The device consists of two etched scale glass thermometers secured in a plastic case and a psychrometric slide rule which forms the cover.

HPAC 4407—HIGH TEMPERATURE INSULATION—"Tempchek," a new heat insulation in pipe covering and block form for temperatures to 1500 F, is now being made by Philip Carey Mfg. Co., Cincinnati 15.

The material consists of silicas, combined with asbestos fibers and bonding agents. It is said to be highly efficient, easily workable, to form tight joints, to be nonirritating, easy to apply, noncorrosive, rugged, and permanent. The new insulation is recommended for use on superheated steam equipment in high temperature, high pressure

UTMOST SIMPLICITY
AND HEATING COMFORT
with SARCOTHERM

The heart of the Sarcotherm System is a simple mixing valve which has been proven in service for a quarter of a century. The mechanisms are strictly mechanical — no electricity or compressed air. Nothing could be simpler or more dependable.

NO "COLD SEVENTIES"

and no "on and off" control with Sarcotherm. It's a simple proportioning three way valve that mixes hot water from the boiler with the cooler return water, giving modulated control at all times.

RADIANT HEAT

Continuous circulation with modulated control is ideal. Inside control is by the exclusive Sarcotherm heat-loss thermostat. Thirty years of experience with Radiant Heating is built into every Sarcotherm job.

CENTRALIZED PANEL CONTROL SYSTEMS

Sarcotherm has available completely automatic centralized panel control systems for apartment houses, schools and other public buildings. Complete control programs furnished to suit particular requirements.

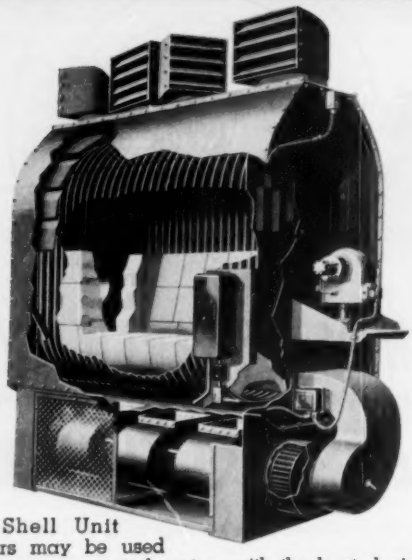
Architects and Heating Engineers like Sarcotherm because it is so flexible. Split systems, automatic night set-back and morning pick-up are easily arranged. Lower boiler temperatures, less fuel used and invariably a lower cost of installation, make Sarcotherm the ideal for engineers who are in daily competition.

Ask for the new catalog, engineering data and sales helps.

Sarcotherm

SARCOTHERM CONTROLS, INC. • Empire State Bldg. • NEW YORK 1, N. Y.

LEE SHELL UNIT HEATER



Lee Shell Unit Heaters may be used singly or as a central system with the heated air distributed through ducts.
The efficiency of Lee Counter-current flow reduces fuel consumption while the rugged simplicity of the system decreases cost of installation, assures low maintenance charges and provides ventilation without additional cost.

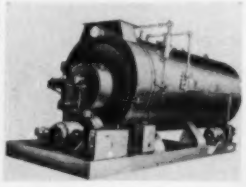
The LEE line . . .
Steel Encased Tubular Heater
Tubular Unit Heater
Brick-Set Tubular Heater
Shell Unit Heater
Write now for more information

LEE ENGINEERING CO.
95 RIVER ST. HOBOKEN, N. J.

power plants and for high temperature surfaces such as oil stills, ovens, boiler walls, breechings, furnaces, and other equipment.

HPAC 4408—PACKAGED STEAM GENERATOR—The new model C300 package type steam generators may be fired either with light oil, heavy oil, or gas and may be used for combination gas and oil operation.

Available in pressures from 15 to 200 psi, it is shipped fully equipped with an integral burner, automatic safety and operating controls, steam trim, valves and other equipment. The entire boiler surface is covered with glass fiber insulation over which is fitted a metal jacket.
Cyclotherm Corp., Oswego, N. Y.



Packaged Steam Generator

Right: Tube End Expander

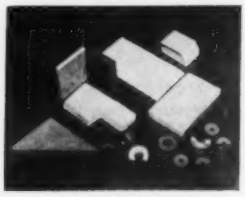
HPAC 4409—TUBE END EXPANDER**—The new "Expando" tube end expander tool is recommended for use with soft and hard copper, aluminum and steel tubes.

The expanded tube is slipped onto the connecting tube and the joint is soldered. Present models are equipped with the dies necessary for the expansion of ⅜, ½, ⅝, and ¾ in. tubes ⅛ in. thick. Each tube is said to be expanded the amount of the thickness of the metal, holding to a tolerance of ±0.002 in.
Knuth Engineering Co., 2617 N. St. Louis St., Chicago.

HPAC 4410—OIL BURNER MOTOR—A new streamlined fractional horsepower motor of the split phase type is designed specifically for use on oil burners.

All mounting dimensions of the motor are standard, but the overall dimensions are relatively small. The motor is said to be easily cleaned and to have a starting current within the recognized limits.
Century Electric Co., 1906 Pine St., St. Louis 3.

Oil Burner Motor



Molded Silicone Rubber

HPAC 4411—MOLDED SILICONE RUBBER—Processes for the production of molded silicone rubber of "uniform cellular composition" have been perfected by Sponge Rubber Products Co., Shelton, Conn.

The new product can be furnished in sheets; cord, strips and tubes; die-cut shapes; and molded forms. The cell structure may be of chemically blown interconnect-

ing cells or noninterconnecting (closed) cells. The process is said to yield a cellular rubber identical to natural cellular rubber in all considerations of uniform cell structure, compression, flexing, tensile, and softness, except that these characteristics are retained at high and low temperature extremes. Other attributes claimed are excellent chemical stability and nontoxic properties.

Said to weigh less than half the weight of mechanical rubber, the new product is recommended as insulation against shock, vibration, sound, and the passage of liquids, air, and heat where extreme degrees of temperature are encountered.

HPAC 4412—TUBING WITH COPPER CORE, STAINLESS STEEL SURFACE—Cold drawn seamless tubing of "Rosslyn" metal, copper core with stainless steel surfaces, is now available from American Cladmetals Co., P. O. Box 544 Carnegie, Pa.

According to the manufacturer the copper provides swift heat transfer while the stainless steel surfaces, to which the copper is bonded, provide hardness, resistance to corrosion and ease of cleaning.

The size range is expected to be from ⅜ to 1½ in. OD and from 0.020 to 0.078 in. wall thickness.

HPAC 4413—FLUE CLEANER—A new "Electric Eel" power flue cleaner is designed to save time, labor and money in removing scale and soot from boiler tubes.

The portable unit can be operated by one man and is powered by a ½ hp electric motor with built-in back gears which reduce the speed from 1725 to 500 rpm. The power cable is designed so that the inner cable rotates inside a stationary outer sheath. Combination brush and spring loaded cutting tools are available for tube sizes from 2 to 4 in.

Ohio Tool and Engineering Co., Springfield, Ohio.

Flue Cleaner

Insulating Concrete

HPAC 4414—ELECTRIC PANEL HEATING—"Electradiant" heating is a combination of electric heating coils and vermiculite insulating concrete and is said to assure even distribution of heat over floor areas.

The system operates on a low voltage, high current principle, with thermostatic control designed to operate at a fraction of 1 deg temperature differential. Unusually close temperature control is said to be possible because of the base of lightweight insulating concrete under the cables, which may be installed in floors, walls, or ceilings. In the illustration, tile flooring is being laid over the system.

Zonolite Co., 135 S. La Salle St., Chicago 3.

...Digging for facts

ON AUTOMATIC REGULATING VALVES?

YOU'LL FIND THESE KLIPFEL BULLETINS PRACTICAL, FACTUAL AND USEFUL!

Klipfel engineers have put a lot of experience and research into these bulletins to make them useful to you . . . the man who uses or specifies automatic regulating valves. Each bulletin covers such points as: the advantages and limitations of different valve constructions; selecting the proper type valve for given operating conditions; determining the most effective and economic size valve for the job.

In short, Klipfel engineers have prepared these bulletins to assist you in selecting the type and size valve best suited to your needs.

Write Dept. C-6 for any bulletins you wish. We'll gladly send them to you.

KLIPFEL REDUCING VALVES

for steam, air and water . . . in lever and weight, air loaded, pilot control and spring loaded types; descriptions, illustrations and complete selection data in Bulltin 148.

KLIPFEL FLOAT VALVES

Single and double seated types with direct action or pilot control for remote location. Types shown include quick-acting valves; all are available in angle and globe patterns. Bulletin 349.

KLIPFEL THERMOSTATIC VALVES

vapor pressure operated valves with spring or weight and lever loading. Valves are ball type, balanced cup and disc or balanced inner valves. Min. temp. 80°. Max. temp. 250°. Range limit of any instrument 40°.

KLIPFEL BACK PRESSURE AND RELIEF VALVES

for control of air, steam and water pressures at the valve inlet in various types for practically any service. Bulletin 648 gives complete details including dimensions and capacities.

Klipfel VALVES INCORPORATED

DIVISION OF HAMILTON-THOMAS CORPORATION, HAMILTON, OHIO

NEW!
individually
REGISTERED
and completely
GUARANTEED
ROXCO
ROXCO
TRIMONT MFG. CO. ROXBURY MASS. U.S.A.
Special
Money-Back Trial Offer!
Buy one "Registered" Roxco and use it for your toughest jobs. If you don't agree it stands up better . . . is handier, faster to use . . . is a bigger value than any pipe wrench you've ever used . . . return that one trial Roxco direct to us (not the seller), within sixty days with a note of price paid and reason for returning. We will refund your money. This get-acquainted offer good until Dec. 31, 1950.

✓ *Check these "engineered" features*

1. **Extra Strength** from extra metal put at critical points . . . withstands heavy "side pull" . . . saves costly failure.
2. **Lighter, Handier** because useless metal is eliminated.
3. **Stronger Jaws** of drop-forged alloy steel, with induction hardened teeth but a tough core.
4. **Reinforcing Shoulder Behind Jaw** resists unusual stress.
5. **Rapid Ratcheting Action** — New cushion action, with tooth design, avoids seizure and permits fast work. Parts fit accurately — less lost motion.
6. **Wide, Palm-fitting Handle** makes work easier, cuts worker fatigue.
7. **Reinforced Housing** embodies hammer face to break cast fittings.
8. **Handy, Accurate Pipe Scale** permits quick adjustment to size.

Special Metallurgical Formula— Roxco Metal, and scientific heat treating, mean superior strength in housing and handle.

A Brute for Strength . . . A Beauty to Handle! Now you need not tolerate useless weight in order to get a dependably strong pipe wrench. Through stress analysis during design, useless metal that means tiring weight was engineered out of the new *Roxco.* Extra metal, exactly where needed for extra strength, was engineered in!

The lighter, handier, faster-working *Roxco* actually exceeds strength requirements of Federal Specifications for Heavy Duty Pipe Wrenches, Type II, GGG-W-651a. Scientific design, special alloy metal and careful quality-control enable us to register every *Roxco* by serial number and guarantee *every* part of it against breakage in any normal heavy duty use! Made in sizes from 6 in. to 48 in. Write for folder and names of local suppliers.

TRIMO-ALLOY WRENCH . . . Roxco's only Rival . . . is an all alloy-steel heavy duty pipe wrench long famous for ruggedness. Different in design, but has power comparable to Roxco.

TRIMONT MANUFACTURING CO.
Division of Aetna Industrial Corporation
55 Amory Street, Roxbury 19, Mass.
Makers of Wrenches, Pipe Cutters, Vises and Other Trimo Time-Tested Tools

HPAC 4415—STEEL BOILERS—Crotty Mfg. Corp., 133-15 Thirty Fifth Ave., Flushing, N. Y., has incorporated new features in its line of steel boilers which are said to make for greater efficiency and operating economy.

Among the new improvements are increased furnace volume, a high firebox, a special design of combustion chamber, improvement in the design and relocation of instantaneous and tank type heating coils, the use of a single door opening for easier inspection and cleaning of tubes and chamber, and jacket streamlining for improved appearance.

WE HEAR THAT . . .

A new air pollution and industrial hygiene mobile laboratory, the only one of its type in the country, has been placed in service by the Bureau of Industrial Hygiene, State of Pennsylvania. Designed and supplied by **Mine Safety Appliances Co.,** Pittsburgh, the laboratory is equipped with more than 25 devices for field sampling and quantitative and qualitative analyses of the atmosphere in industrial communities and factories. . . . . **Crane Co.,** Chicago, has opened a new branch at 132-134 N. Kansas Ave., Topeka, Kans., to cover the northern and central portion of the state formerly serviced from the branch in Kansas City. **Ned S. Edwards,** formerly assistant manager at the Kansas City branch, is in charge.

Fisher Governor Co., Marshalltown, Iowa, is now manufacturing controllers and regulators in Great Britain. Address of the new office and plant is **Fisher Governor Co., Ltd.,** Lewisham, London, S.E. 13, England. Equipment carries the Fisher trademark and is built to the same specifications and standards as that made in this country. Interchangeable parts are available from the London or Marshalltown plant. Products marketed by the British company are being manufactured by Elliott Bros. (London) Ltd. . . . . As part of a program to study modern manufacturing, production, and quality control methods, a group of student officers from the U. S. Naval Postgraduate School, Annapolis, Md., recently visited **York Corp.,** York, Pa. Included in the group were a number of naval officers from this country, Brazil, and Argentina.

New, modern industrial research and development laboratories are being constructed for **Armstrong Cork Co.,** Lancaster, Pa. To be ready for use early next year, the buildings will include a main research building, a single story pilot plant, and smaller pilot plants. . . . . The Cincinnati district office of **Tinnerman Products, Inc.,** Cleveland, has been moved to Roselawn Center Bldg., 1717 Section Rd., Cincinnati 37. **Jack McLaughlin** is manager of the district, which consists of southwestern Ohio, Kentucky, southeastern Indiana, and southeastern Illinois.

Auer Register Co. is now occupying a much larger plant at 6600 Clement Ave., Cleveland. Streamlined production prevails and facilities include electric hoists and a quarter mile long conveyor line. . . . **A. M. Byers Co.,** Pittsburgh, is again offering wrought iron sheets. Flat and corrugated hot rolled annealed wrought iron sheet, black as well as galvanized, from 8 to 22 ga, is available.

B. S. Williams Co., Inc., 6 North St., Mt. Vernon, N. Y., is a newly organized firm which will design, develop and manufacture railroad air conditioning and refrigerating equipment and will operate a factory rebuilding and accessory parts service. In addition the company will handle liquid cooling and other specialized applications in the industrial and commercial fields. **B. S. Williams,** president, is well known in the air conditioning and refrigeration industry. He was with York Corp. for 13 years and subsequently spent 12 years with Chrysler Corp., where his last position with that firm was director of industrial research for the Airtemp Division.

The new physical, chemical, and metallurgical laboratories of **Edward Valves, Inc.,** East Chicago, Ind., formally opened less than a year ago are being increased nearly 50 percent in size with the construction of a new unit. The addition will house special equipment for testing valves and piping under fluid flow. Test boilers, compressors, pumps, and other equipment will permit the use of gases and liquids at pressures up to 5000 psi and temperatures up to 1500 F. ..... A new sound film showing the uses of vermiculite products in construction has been issued by **Vermiculite Institute,** 208 S. La Salle St., Chicago 4. With a running time of about 18 min, the film is available for use in colleges, short courses, and group meetings of all kinds.

Madden Brass Products Co., Chicago, is now exclusive distributor of the water regulating valves manufactured by **Perfection Gear Co.,** Harvey, Ill. Sales, distribution and all related details are being handled from the distributor's office. ..... **Crise Mfg. Co.,** Columbus, Ohio, has been expanded by a merger with **Acro Switch Co.,** which has been moved from Cleveland to Columbus, and is now known as the **Acro Switch Div., Crise Mfg. Co.** Purchase of the **MU Switch Division** from the **Chase-Shawmut Corp.,** Canton, Mass., brings another line of electrical equipment to the Crise firm. It will be operated as the MU Switch Division of the Columbus company.

DeVilbiss Co., Toledo, has opened a new assembling, warehousing, and distributing plant in Santa Clara, Calif. Serving the territory covered by sales branches in San Francisco, Los Angeles, and Salt Lake City, the plant has been set up to permit carload shipments of parts for assembly in Santa Clara, with consequent reduction in freight charges.

Within the next three years, **Allegheny Ludlum Steel Corp.,** Pittsburgh, will complete a new $23.6 million plant improvement program which is in addition to a $30 million five year program started immediately after the war and now in the final stages of completion. Manufacturing improvements will include a new hot strip mill and additional cold rolling facilities at the Brackenridge plant and additional cold rolling equipment at the West Leechburg, Pa. plant. In addition, a new research laboratory will be constructed.

Seamless steel tubing of **Spang-Chalfant Div., National Supply Co.,** Pittsburgh, is now being identified by the use of raised letters and symbols. A marking wheel is used to permanently stamp products and to show type of

Underbid Competition with "Water-Refrigerant"

Jaden **Newly Designed AIR CONDITIONERS**

Floor Model

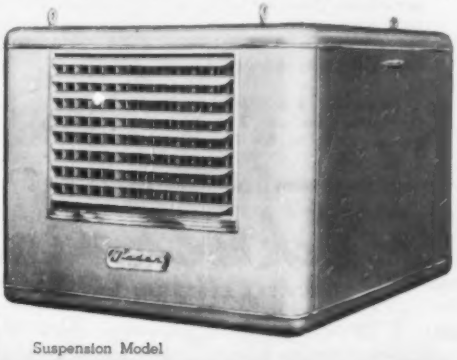
Is yours a "cold water" area? If so, just think of the advantages you'll have with the Jaden line of "Water-Cooled" air conditioners! **SIMPLER IN DESIGN . . . LOWER IN PRICE . . . LESS COST TO OPERATE!** There's nothing can compare with the Jaden for cooling economy. You'll underbid every competitor.

CHOICE OF MODELS AND SIZES. Suspension and floor units. For private offices, living room, hospital room, barber shop, beauty parlor—up to cafes, stores, banks, shops, etc.

ALL-YEAR USE. Cold water COOLS in summer. Hot water HEATS in winter.

DEALERS

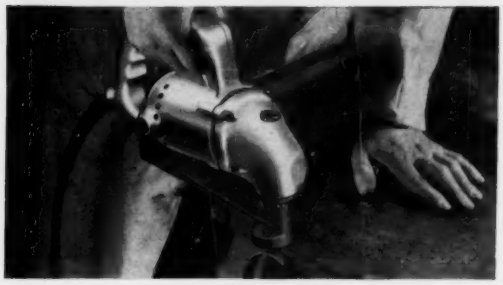
If you are located in a cold water area (60° or less) write now for catalog and full information.



Suspension Model

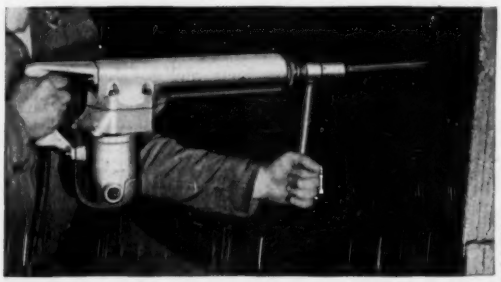
JADEN MFG. COMPANY ..... Hastings, Nebr.

7 ways to SPEED UP SHEET METAL WORK



3 ***BLACK & DECKER ELECTRIC PORTO-SHEARS**** cut sheet metal too tough for snips. Speed up jobs where snips are slow. Save you time and cut costs on hundreds of jobs. Fast, powerful shearing action eliminates hard muscular strain. Cutting operation *always* visible. Cut straight lines, irregular lines, curves to a minimum radius of ¾". Three models: 12, 16 and 18-gage capacity.

*Trade Mark Reg. U. S. Pat. Off.



4 ***BLACK & DECKER ELECTRIC HAMMERS*** speed up such jobs as drilling holes for toggle bolts in concrete and brick—cutting mortar out of joints to install flashings—removing rust, weld spatter, old paint from sheet metal. High-speed, amazingly husky, deliver thousands of sharp, positive hammer blows per minute. Drive star drills, speed bits, chisels, many other tools. Light, compact, completely self-contained, require no transformer or extra equipment. Four models: rated by drilling capacity in concrete for ½", ¾", 1⅛", 2".

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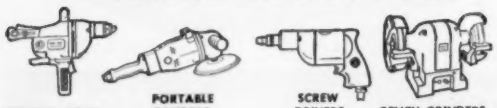

ELECTRIC DRILLS · PORTABLE SANDERS · SCREW DRIVERS · BENCH GRINDERS

tubing and other information. ..... A newly completed construction program at the Red Bud, Ill., plant of **American Furnace Co.**, St. Louis, marks the third enlargement of production and storage facilities made by the company since the end of the war. Contracts have also been let for the construction of an office and warehouse building in St. Louis.

Guardian Products Corp., Michigan City, Ind., has enlarged its plant space nearly 100 percent by construction of a new addition which is being used for the production of various types of valves. The original plant space is now entirely devoted to the manufacture of flexible couplings. ..... **Natural Gas Equipment, Inc.**, has moved its offices to 190 E. Glenarm St., Pasadena, Calif. The new location provides increased office space and warehousing facilities. The firm was recently named representative in California, Oregon, Washington, and Arizona for the products of **Valve and Primer Corp.**, Chicago, and has for many years been representative for a number of well known manufacturers of gas equipment.

Ranco, Inc., Columbus, Ohio, is now negotiating the establishment of a new plant in England. The plan is to set up a factory for assembling thermostatic controls which will be shipped to other foreign markets, as well as distributed in England. . . . . The W-52 arc welding electrode recently developed by the apparatus dept. of **General Electric Co.**, Schenectady 5, N. Y., is available in $\frac{5}{32}$ and $\frac{3}{16}$ in. diameters. It is a carbon-molybdenum electrode specifically designed for welding low alloy, high tensile steels, such as pipe lines, in all positions. It is recommended for use in the welding of high pressure piping.

Babcock & Wilcox Co., 85 Liberty St., New York 6, has developed a "cyclone furnace" designed to burn low grade, high ash coal with a minimum of fly ash discharge and minimum slagging difficulty. Developed for large industrial boilers and to generate heat at temperatures up to 3000 F, it handles crushed coal and other fuels in a whirling flame. Centrifugal action is used to throw noncombustible residue against the furnace walls, to melt and drip into a pit as slag.

Aluminum Co. of America, 801 Gulf Bldg., Pittsburgh 19, is marketing forged aluminum manhole steps and ladder rungs for municipal and industrial installations. Three sizes are featured, adaptable to concrete, brick, or concrete block wall construction. Advantages stressed by the company include high strength, corrosion resistance, and nonsparking characteristics.

A new "Silastic" insulating tape for application by vulcanization has been developed by **Irvington Varnish & Insulator Co.**, Irvington 11, N. J. It consists of "Fiberglas" cloth impregnated and coated on both sides with a rubberlike dielectric said to withstand unusually high temperatures. On one side of the tape the rubber is completely cured and on the other it is partially cured so that when heated for vulcanization, a solid mass of insulation is formed. In addition to many uses in connection with electrical equipment and wiring, it is recommended for sealing warm air ducts and pipes.

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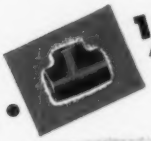

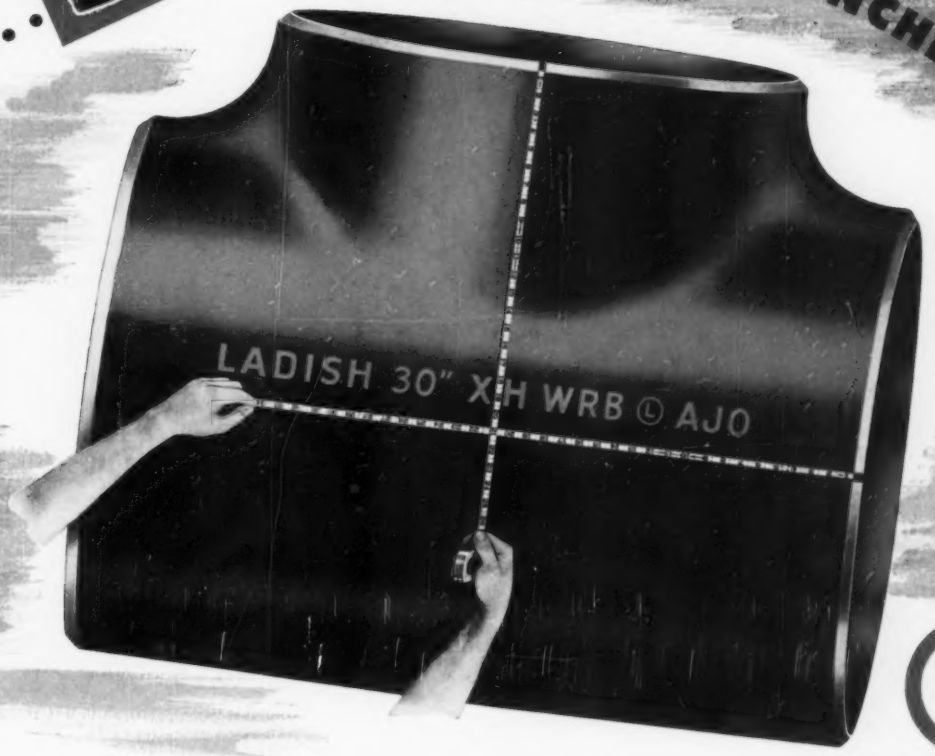

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To increase safety, ease of installation and welding accessibility . . . Ladish Welding Tees have Full Branch Outlets with identical center-to-end dimension of branch and run as is required for each size *through 30 inches.* Scientific metal distribution . . . pioneered by Ladish . . . adds extra protection by equalizing stress over the entire fitting and assuring maximum strength in every cross section.

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here's low-cost protection for PRESSURE-LUBRICATED COMPRESSORS

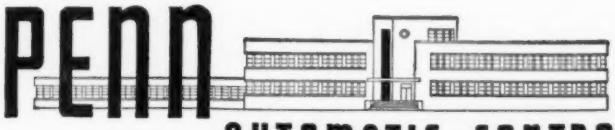
Low lube oil pressure . . . or slow pickup of oil pressure at the start of a cycle can happen in the best of pressure-lubricated refrigeration compressors. And when it does . . . damage to seals and bearings may result. But, you don't have to take this gamble anymore!

Now . . . for the first time . . . you can have life-time protection against such compressor breakdowns with the new PENN Series 275 Oil Protection Control with built-in Time Delay Switch.

Then, when the compressor starts, if the oil pressure does not build up to the proper point within a safe time period, the PENN 275 stops the compressor *automatically* before damage can occur. If oil pressure drops below a safe minimum during the running cycle . . . and does not rise to normal within the time delay period . . . the control shuts off compressor operation.

Thus, the compressor never operates more than the predetermined safe time on subnormal oil pressure. Result? Positive, automatic protection at all times!

Investigate this new, low-cost protection for refrigeration compressors or for other pressure-lubricated equipment. For complete information ask your compressor manufacturer or wholesaler or write **Penn Electric Switch Co., Goshen, Indiana.** Export Division: 13 E. 40th St., New York 16, U. S. A. In Canada: Penn Controls, Ltd., Toronto, Ont.



AUTOMATIC CONTROLS

FOR HEATING, REFRIGERATION, AIR CONDITIONING, PUMPS, AIR COMPRESSORS, ENGINES, GAS RANGES

WHO'S WHAT

Walther H. Feldmann has resigned as president of **Electric Machinery Mfg. Co.**, Minneapolis, a subsidiary of **Worthington Pump and Machinery Corp.**, Harrison, N. J. He is now vice president in charge of sales for Worthington and has been succeeded in Minneapolis by **Richard H. Olson,** formerly vice president in charge of sales. Other recent personnel changes at Worthington include the appointment of **John J. Summersby** as vice president in charge of purchases. **Frederic W. Thomas** is general manager of purchases and **Carleton Reynell** is general representative, sales and purchasing departments.

Frank Purnell, who joined **Youngstown Sheet and Tube Co.**, Youngstown, Ohio, in 1902 and who has been president since 1930, is now chairman of the board of directors. The newly elected president is **J. L. Mauthe,** who joined the firm in 1935 and who has been vice president in charge of all operations since 1943. **Alfred S. Glossbrenner,** assistant vice president in charge of steel operations at all plants, has been elected vice president in charge of operations.

Roy C. Ingersoll, previously vice president, is the new president of **Borg-Warner Corp.**, Chicago, succeeding **C. S. Davis** who has been president for the past 21 years, and who is now chairman of the board. **G. A. Shallberg,** previously executive vice president, has been named chairman of the executive committee. Mr. Ingersoll, in addition to his duties as president, will assume those formerly assigned to the office of the executive vice president.

W. B. Russell, for the last five years vice president of **Kewanee Boiler Corp.**, Kewanee, Ill., is now president, filling the vacancy created by the death of **R. B. Dickson.** Mr. Russell, who is also a director, has been succeeded as vice president by **E. M. Palmer** who has had the title of vice president, general manager, sales.

Edwin S. Pillsbury, one of the founders of **Century Electric Co.**, St. Louis, and president since 1914, has relinquished his post and has been succeeded by his son, **Fred H. Pillsbury,** who has been vice president in charge of operations since last July and a member of the board of directors since 1942. The elder Pillsbury will continue as chairman of the board of directors. . . . **Armstrong Cork Co.**, Lancaster, Pa., has elected **C. J. Backstrand** president, and **H. W. Prentis, Jr.**, chairman of the board. Mr. Prentis has retired as president after serving 16 years in that capacity. **Kenneth O. Bates** has been re-elected vice president and designated executive vice president.

As the new executive vice president of **A. O. Smith Corp.**, Milwaukee, **J. M. Floyd** will take over general operating supervision of the company. He had been vice president in charge of manufacturing. . . . **Burgess H. Jennings,** chairman, department of mechanical engineering, Northwestern University, and engineering consultant to the Argonne National Laboratory, has been elected a Fellow of the **American Society of Mechanical Engineers.** He is the author of many papers and textbooks.

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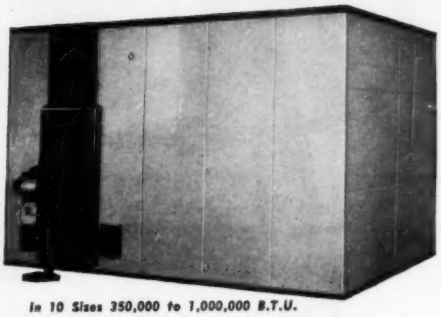

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Mark A. Brown, president, Harris Trust and Savings Bank, Chicago, has been elected to the board of directors of **American Radiator & Standard Sanitary Corp.,** Pittsburgh, to fill the vacancy caused by the death of Robert B. Dickson, president of Kewanee Boiler Corp. **Clark T. Morse,** president of American Blower Corp., and a member of the American-Standard board of directors, has been appointed to the executive committee, a post which Mr. Dickson also held. Both Kewanee Boiler Corp., and the American Blower Corp., are subsidiaries of American-Standard.

H. G. Ebdon and **William P. E. Ainsworth** are new vice presidents of **Combustion Engineering-Superheater, Inc.,** New York. Mr. Ebdon became general sales manager of boilers and related equipment in 1941 and will continue in that capacity. Mr. Ainsworth has been general purchasing agent since 1939 and since 1942 has also been production manager.

Frank C. Jones, manager of the Bridgeport plant for the past nine years, is a new board member of **Handy & Harman,** New York. **Thomas G. McMahon,** formerly a director, has resigned and **Judson C. Travis,** newly elected vice president, is responsible for the sales, manufacturing, refining and research operations of the company and has general charge of its five plants. **Howard W. Boynton,** who is now a vice president, will continue to serve as treasurer but not as secretary. **Robert H. Leach** has retired from active management but will act as a consultant and advisor in matters concerning production, research and metallurgy and continues as a vice president. **John W. Colgan** is also a newly elected vice president, in which capacity he will function as sales manager. **Richard G. Jones** is the new secretary.

Oliver Dobson has been named sales manager of **Automatic Devices Co. Inc.,** Chicago. He has a broad background of experience and was formerly connected with U. S. Gypsum Co. as assistant sales manager and was also sales manager for Economy Electric Mfg. Co. and Sampsel Time Control, Inc. He will operate out of the New York office. The new assistant sales manager is **Edward Hartnett** who is in charge of installation and servicing and will work out of the Boston office in direct charge of the New England area.

Aubrey V. Baber has been promoted to assistant general sales manager of the **Kaylo Div., Owens-Illinois Glass Co.,** Toledo. He was the first sales employee of the division and later become manager, insulation sales. In his new position he will serve in the dual capacity of manager, insulation sales and assistant general sales manager.

The air conditioning dept. of **General Electric Co.,** Bloomfield, N. J., has established a new sales division in the marketing organization. The new division will be responsible for the sale and servicing of automatic heating equipment, air conditioning equipment, refrigeration machines, commercial refrigeration, and water coolers. **H. M. Brundage,** manager of the former automatic heating division, is in charge of the new division and **Harry J. Wines,** formerly manager of automatic heating sales, has been named manager of distribution sales. The responsibilities of **J. D. Hoffman,** manager of direct sales, and

L. E. Thompson, manager of parts sales and product service, have been extended to include heating equipment as well as cooling equipment lines.

Sturtevant Div., Westinghouse Electric Corp., Hyde Park, Boston, Mass., has realigned its sales organization by the formation of two new departments, one to concentrate on sales of air conditioning products, and the other on air handling equipment. **T. E. Smith** is in charge of air conditioning sales and manager of the air handling sales department is **Phillip Cohen.** Both departments are under the supervision of **J. C. Thompson,** general sales manager.

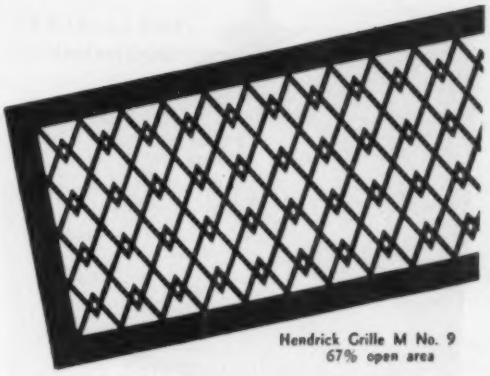
Gene D. Sickert is now works manager of the Indianapolis plant of **Peerless Pump Div., Food Machinery and Chemical Corp.,** Los Angeles. He comes to Peerless from the Bolens Products division of Food Machinery where he has held a similar position for the last four years. He succeeds **L. H. Stermer,** resigned. . . . Formerly associated with the central research department of **Koppers Co. Inc.,** Pittsburgh, **Earl V. Harlow** has been named engineering assistant to **Walter S. Perkins,** vice president and general manager of the metal products division. He is assisting on engineering matters and is coordinating research and development projects.

The **Air Conditioning and Refrigerating Machinery Association** has elected **T. E. Smith,** of Westinghouse Electric Corp.; **F. W. Smith,** of Baker Refrigeration Corp.; and **T. E. Hoye,** of Savage Arms Corp., to its board of directors. . . . **E. H. Forsstrom,** who has been assistant manager of the Watervliet, N. Y., plant of **Allegheny Ludlum Steel Corp.,** Pittsburgh, has been appointed to the newly created position of director of training. **W. J. Baldwin,** chief metallurgist of the Watervliet plant, has succeeded him.

The southern portion of the sales territory served by the St. Louis electrical division branch of **Wagner Electric Corp.,** St. Louis, has been set up as a separate unit, with headquarters in Memphis and a sales office in New Orleans. **A. C. Allen** remains in Memphis as branch manager of the newly established territory. The remaining territory, with a main branch in St. Louis and a subbranch in Indianapolis, is under the direction of **J. J. Scheid,** who succeeds **H. N. Felton,** manager of the St. Louis branch. Mr. Felton was recently elected vice president in charge of sales.

Harry L. Quinn is now directing sales of all products, excepting those in the oil and gas division, of **Refrigeration Engineering, Inc.,** Los Angeles. He joined the company a year ago and has been sales manager of its air conditioning division. **Harold Jarvis,** son of **Hy Jarvis,** vice president and general manager has joined **Gilman & Co., Ltd.,** Recold distributor in Hong Kong, China.

Newly elected officers of the **Sheet Metal Contractor's National Association** are: president—**W. A. Wiedenmann,** Kansas City, Mo.; first vice president—**E. B. Brown, Jr.,** Chicago; second vice president—**M. J. Cutter,** Cleveland; third vice president—**A. J. Sabathne,** Altoona, Pa. **C. M. Gundlach,** Sandusky, Ohio, and **J. D. Wilder,** Elgin, Ill., continue as treasurer and executive secretary respectively.



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FAMOUS Lo-BLAST BURNER NOW OFFERED IN CAPACITIES FROM 75,000 TO 20,000,000 BTU
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Mid-Continent power burners, both the Economite and the standard Lo-BLAST, are durable, long-lasting, shipped assembled, easy to install. Fuel saving and efficiency is assured when you install any of these burners.

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1960 N. Clybourn Ave., Chicago 14, Ill.

Formerly advertising manager of Culligan Zeolite Co., **Lewis M. Russell** has been named advertising and sales promotion manager for **Mitchell Mfg. Co.**, Chicago. **Mytelka & Rose, Inc.**, New Jersey appliance distributor, is now handling Mitchell room air conditioners. . . . Specializing in the mechanical engineering branch of the construction industry, **Rutherford L. Stinard** has opened a consulting office at 51 E. 42nd St., New York City. He was formerly with the New York City office of The Trane Co.

Ervin J. Bookout is managing eastern sales of **Cochrane Corp.**, Philadelphia. He has been with the firm for many years as sales engineer in the Philadelphia territory, and prior to that in the company laboratories. . . . **A. E. Higgins** is occupying the newly created post of manager, gas utility relations, air conditioning dept., **General Electric Co.**, Bloomfield, N. J. Creation of the new position is in line with the company's increased activities in the gas heating field. Prior to the appointment, Mr. Higgins was vice president of the Rockwell Mfg. Co., International Div.

Fred T. Ramsey is now managing sales of **Ramsey-Bennett Co.**, Cleveland, Ohio, distributor of commercial refrigeration and air conditioning units. . . . **Carl E. Johnson,** for many years president of **Sterling Electric Motors, Inc.**, Los Angeles, has been elected board chairman and has turned over the active direction of the firm to **Earl Mendenhall,** the new president, with whom he has been associated for over 34 years.

William G. Christy has been appointed director of the **Bureau of Smoke Control** of the city of New York by Mayor William O'Dwyer. He was one of the organizers of the Citizens Smoke Abatement League of St. Louis in 1925 and served as its executive secretary. In 1930 he went to Jersey City where he organized the first county smoke control unit in the country. In his new job he is chairman of the Board of Smoke Control and is in charge of smoke and dust abatement in the five boroughs of New York City. **Rear Admiral William S. Maxwell,** recently retired after a career in the Navy, is deputy director and one of the five members of the Smoke Control Board.

Paul Garrett has been transferred to the home office of **York Corp.**, York, Pa. He had been commercial service supervisor of the southwest district, Houston, Tex., and is succeeded by **Frank Fairfield,** formerly commercial service supervisor in the Seattle office.

National Radiator Co., Johnstown, Pa., has established a branch sales office at 5736 Twelfth St., Detroit 8. The territory covered includes the state of Michigan and portions of Ohio. The new branch manager is **Victor W. Blackney** who, prior to joining the company last year as educational director, had been with U. S. Radiator Corp. **I. P. Newby** is handling sales representation in the southwest Texas territory. From 1947 until a few months ago he managed the heating department of Rheem Mfg. Co.'s southwestern region. He is now located at 6262 Prospect Ave., Dallas 14. The new representative in Minnesota, North and South Dakota, and Iowa is **Twin City Sales,**

1600 Broadway, N. E., Minneapolis 13. **William A. Prees** is manager of the firm and is assisted in the Minneapolis and Dakota territory by **Roger A. Matson. S. T. Carlson** and **W. D. Lindholm** cover the Iowa territory.

Strong, Carlisle & Hammond Co., Cleveland, has appointed nine new distributors. They are: **Georgia Hardware & Supply Co.**, Albany, Ga.; **Woodbury & Co.**, Portland, Ore.; **Parker Helms & Langston Co.**, Brunswick, Ga.; **Gondas Corp.**, Miami, Fla.; **Industrial Equipment and Supplies**, Miami, Fla.; **Wilmington Iron Works**, Wilmington, N. C.; **Mott Bros. Co.**, Rockford, Ill.; **M. P. Wilkins Supply Co.**, Toledo, Ohio; and **Charles Manoog, Inc.**, Worcester, Mass.

Gordon S. Schuhmacher is the new district manager in Los Angeles for **Hagan Corp.**, Pittsburgh, and its subsidiaries, **Calgon, Inc., Hall Laboratories, Inc.**, and **Buromin Co.** He succeeds **R. L. Sullivan**, resigned, and is assisted by **Joseph R. Shafer.** Mr. Schuhmacher joined Hagan in 1942 for service in the Los Angeles territory. Mr. Shafer joined the company in 1941 as a service engineer.

Surface Combustion Corp., Toledo, has named **Norman L. Kledzik** as sales engineer in the company's Indianapolis territory. He will work as an associate of **R. A. Caylor**, district manager of that territory, in the sale of "Janitrol" products. He has been with the company since 1948. . . . **John L. Shank** is handling representation in the Indianapolis territory for **Taco Heaters, Inc.**, Providence, R. I. He has worked in the engineering department of two wholesalers for 15 years, was a mechanical engineer for the U. S. Navy and for the last two years he has been a manufacturers' representative.

With headquarters at the company's plant, **Arthur H. Brodie** is district manager of **Tube Turns of Canada, Ltd.**, Chatham, Ont. Before joining the company he was associated with International Equipment Co., Toronto. . . . **Refrigerating and Power Specialties Co.**, San Francisco, is now handling the selling and servicing of equipment manufactured by **C. A. Dunham Co.**, Chicago. The territory covered includes northern California and western Nevada. **A. F. Tudury** is president of the west coast firm.

Rittling Corp., Buffalo, N. Y., has named **Paul Thompson & Co.**, 231-47 N. 3rd St., Philadelphia, as sales and warehousing representative in eastern Pennsylvania, southern New Jersey, Delaware, Virginia, District of Columbia, and Maryland. Mr. Thompson had been the Philadelphia branch manager for National Radiator Co. since 1942. He recently resigned to form his present organization. Associated with him are **Thomas P. Halligan** and **Carlton J. Ferris.** Both are former sales representatives for National Radiator.

Representation in the Harrisburg, Pa. territory of **Kewanee Boiler Corp.**, Kewanee, Ill., is being handled by **Thomas F. Burke Co.**, 221 N. Second St., Harrisburg. . . . Directors who guided the **Refrigeration Manufacturers Association of Southern California** last year have been re-elected. They are **C. S. Meyers**, Weber Showcase &

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Means Effective Dust Collection
Airsan expanded metal face plate acts as a lint arrestor to provide easier cleaning and servicing and distributes air evenly over entire filtering area, providing high filtering efficiency and dust holding capacity with low resistance. Other features include all galvanized construction and full bronze welded corners.
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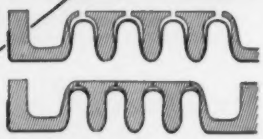

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D-F S-E could mean definite financial savings effected —actually D-F S-E does mean *Directed-Flexing Self-Equalizing. Directed-Flexing, an exclusive construction feature in Badger Joints, is a combination of an all-curve corrugated member and correspondingly shaped Self-Equalizing rings which not only limits the movement of each corrugation but also progressively controls each increment of movement over the area of each corrugation. This construction eliminates localized stresses which cause metal fatigue and break-downs.

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All-curve flexing guarantees longer life

Badger Joints flex like this . . .

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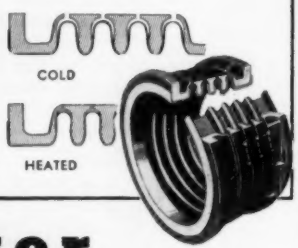
. . . this stress-free flexing principle exclusive with Badger



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Fixture Co.; **R. L. Loop,** Ward Refrigerator and Mfg. Co.; **B. H. Bakke,** Coldew Co.; **B. R. Glazer,** Super-Colde Corp.; and **L. A. Prather,** Refrigerator Manufacturers, Inc. Mr. Meyers is president, Mr. Loop, vice president, and Mr. Bakke is secretary-treasurer.

Formerly associated with A. G. Bauer Co., as an industrial insulation and furnace equipment representative, **Lowell A. McCord,** 1017 Trelane, Webster Groves, Mo., is now district representative in the Missouri-Indiana area for **Viking Air Conditioning Corp.,** Cleveland. He will also cover part of Illinois and Kentucky.

Giffels & Vallet, Inc., and L. Rossetti, associated engineers and architects, Detroit, have opened a new office at 2121 Commerce Bldg., Houston, Tex. **Col. William P. Cornelius,** who has returned to his native Texas from Richland, Wash., where he was chief of the construction and maintenance division, Hanford Atomic Energy Project, has been named manager of the new district office. . . . . **New York Blower Co.,** Chicago, has appointed **A. A. Maycock Co.,** 234 Seventh Ave., Salt Lake City, Utah, representative in that area.

Reviews Literature on Temperature Effects Upon Reaction Time

Limiting temperatures, both high and low, which man can tolerate may be called temperature tolerances and, obviously, must be defined in terms of some satisfactory criterion. For high temperatures, a criterion might be the bare avoidance of collapse. Another criterion which has been used is the reported comfort of persons placed in a given thermal environment. One criterion which has not been used extensively but which has practical significance is the onset of performance deterioration, or the thermal conditions under which human performance is significantly impaired.

In a paper, The Effect of Ambient and Body Temperatures Upon Reaction Time, George Forlano, division of bio-mechanics, Psychological Corp., reviews the literature and examines reaction time studies by a number of investigators.

After analyzing studies for temperatures from —50 F to 117 F, he concludes that (a) reaction time does not vary significantly with low ambient temperatures, provided the body generally and the responding member in particular are properly protected, (b) clothing can adequately protect the body without interfering with the speed of a simple reaction during exposures for several days and to temperatures as low as —20 F, (c) for periods of approximately one hour current-type clothing affords adequate protection against temperatures as low as —50 F, (d) conditions which may reduce strength and dexterity of movement may leave reaction time unchanged, and (e) reaction time does not vary significantly with high ambient temperatures up to 117 F, provided the wet bulb temperature does not exceed about 86 F.

This article is contained in the Vol. 15, No. 4 issue of Technical Data Digest, published by the Central Air Documents Office (Army-Navy-Air Force) Wright-Patterson Air Force Base, Dayton, Ohio.

NEW BOOKS & REPORTS

Says Stainless Steel Can Often Be Welded More Easily Than Other Metals

The welding of stainless steel presents no insurmountable difficulties and in the large majority of cases can be accomplished more easily than with other metals, according to George C. Kiefer, associate director of research, Allegheny Ludlum Steel Corp.

In a paper on the welding of stainless steel, which was presented at the recent Welding Engineering Conference at Ohio State University, he emphasized the fact that, in common with other materials of construction, some problems arise but they are usually associated with specific applications which require special attention in all phases of design and fabrication.

The author divides the uses of stainless steels into four classifications: decorative, sanitary, corrosion, and oxidation (where operating conditions involve high temperatures). Past experience, he reports, indicates that, as far as welding is concerned, no problems generally arise in connection with the first two classifications. The effect of welding on the characteristics of the metal is sometimes important in connection with the last two classifications.

After tabulating the more important types of stainless steels and their welding characteristics, Mr. Kiefer discusses the relatively low heat conducting properties and great expansion when heated. Response to heat treatment, increase in volume when heated or cooled from high temperatures, tempering at relatively low temperature, effects of welding on corrosion resistance, localized heating or torch annealing, and the effect of precipitated carbides are among other topics covered.

ASTM Enlarges Steel Piping Specifications

This latest compilation of American Society for Testing Materials standards on steel piping materials includes some 50 widely used specifications. Materials covered include pipe used to convey liquids, vapors, and gases at normal and elevated temperatures; still tubes for refinery service; heat exchanger and condenser tubes; and boiler and superheater tubes. There are also included specifications for castings, forgings, bolts, and nuts used in pipe and related installations.

There are 16 pipe specifications covering seamless and welded; electric fusion and electric resistance welded, and other types, in both carbon and alloy grades. Several specifications cover materials for service at high temperatures, including austenitic pipe. For boiler, superheater, and miscellaneous tubes there are 13 standards, including three for stainless tubing, ferritic and austenitic, for general service, and for sanitary tubing. Three standards for seamless steel still tubes cover applications in refineries, and three other heat exchanger and condenser tube standards apply to seamless and electric resistance welded tubing of various grades.

Various classes and grades of carbon and alloy steel castings, forgings, welding fittings and bolting are included in 13 specifications. Many of the applications are for high temperature and high pressure service. The publication is made more complete and usable by the inclusion of

DeBothezat Induced Draft Bifurcator Fans can be installed in vertical stack or horizontal or angular breeching. The Bifurcator is a direct motor driven fan with a divided housing. Gases by-pass motor which is isolated in through-ventilated, asbestos lined chamber. For operating temperatures up to 650° F. Also special construction for higher temperatures.

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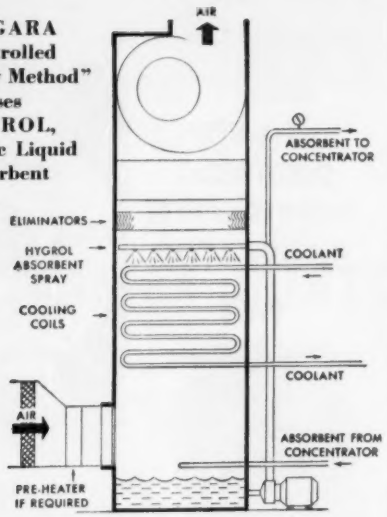

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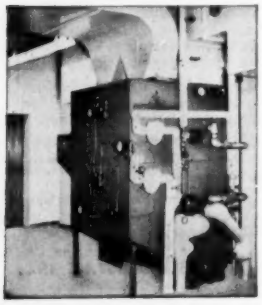
● The "Niagara Controlled Humidity Method" gives complete control of temperature and relative humidity, holding constant conditions or varying them at the will of the user. Especially, it provides dry air at normal atmospheric temperatures with little or no refrigeration required.

The air is filtered and then enters a chamber where it is dehumidified in passing thru a spray of "Hygrol" Liquid (a hygienic hygroscopic chemical that absorbs the air-borne moisture and contains no salts or solids to precipitate). In the same chamber are located cooling coils which remove the latent heat of evaporation and also sensible heat as required.

The absorbent liquid spray falls into a tank at the base, where it is piped to a concentrator, removing moisture taken from the air. The re-concentrated liquid returns to the system. This process is continuous, and the apparatus operates at full capacity at all times.

This equipment is manufactured in a range of sizes providing from 1000 to 20,000 CFM of conditioned air from a single unit.



Installations have been made in food and chemical process industries, in packaging hygroscopic products, for preventing condensation of moisture on metals and other products in storage, in air conditioning for laboratory control and for human comfort.

•

For further information, write Niagara Blower Co., Dept. HP, 405 Lexington Ave., New York 17, N. Y.

Grain Size Standard E 19 and also by the American Standards covering steel and iron pipe (B 36.10) and the latest stainless steel document (B 36.19).

Copies of this 328 page book, heavy paper cover, can be procured from the ASTM headquarters, 1916 Race Street, Philadelphia 3, for $3.00.

Evaluates Human Shape Factors with Respect to Energy from a Heated Floor

Comfort conditions in a heated or cooled enclosure require a stable heat balance between the occupant and his surroundings. By a stable balance is meant one which provides a practically fixed rate of heat loss from the occupant, irrespective of his position (whether standing, sitting, or reclining) and irrespective of his location within the room. Engineering evaluation of stability requires establishing a heat balance on the occupant and investigating the manner in which individual terms of that balance vary with position or location of the occupant.

In his paper, Experimental Evaluation of Human Shape Factors With Respect to Floor Areas, Prof. F. W. Hutchinson, of the University of California, states that the major factor affecting stability is changes in the geometry of the system (consisting of occupant and surroundings) which occur as the occupant alters his position or moves around the enclosure. All such changes are said to appear in the equation for radiant heat transfer between the occupant and the various surfaces of the room, each surface possessing a shape factor with respect to the occupant.

Since the mathematical problem of carrying out a double integration over the complex surface of the human body is virtually insurmountable, Professor Hutchinson used experimental methods for the determination of shape factors with respect to a heated floor and in this paper presents complete results of his investigation for the particular case of an average occupant with respect to points, infinitesimal areas, or finite areas on the floor.

The paper, identified as No. 50-S-4, was presented at the recent spring meeting of the American Society of Mechanical Engineers. Copies may be obtained from ASME headquarters, 29 W. 39th St., New York 18.

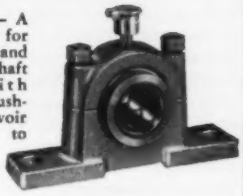
Chemical Engineers' Handbook Revised and Enlarged

The new third edition of the Chemical Engineers' Handbook provides a virtually complete revision of this engineering reference work, including new and comprehensive coverage of both standard and recently compiled facts, figures, and methods applicable to both chemical engineering and its related fields.

More than 140 recognized specialists have contributed detailed explanations of new developments in every branch of the industry, including those of recent years. Many chapters have been expanded and revised and others have been completely rewritten. Improvements include an increased coverage and new treatment of low temperature refrigeration and processes; extensive revisions to the material on the flow of fluids, heat transmission, solvent extraction, mixing, absorption; and a new presentation of information on humidification, dehumidification, spray ponds, and cooling towers. The material on fuels, refrigeration, materials of construction, safety and fire protection, and accounting and cost finding has been thoroughly revised. A considerable amount of new material has been added to the sections dealing with size

THERE'S A RANDALL PILLOW BLOCK FOR EVERY TYPE APPLICATION

Normal Duty Pillow Block — A general service pillow block for normal duty on small shafts and for heavier duty on larger shaft sizes. Double-lubricated with graphited, phosphor bronze bushing in wool packed oil reservoir housing. For shafts 1¼" to 3 15/16" inclusive.



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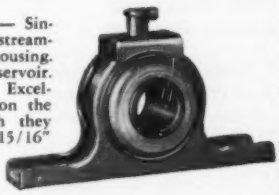

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reduction, power generation, process control, high pressure technique, plant location, gas absorption, and movement and storage of materials. More than 2000 charts, diagrams, flow sheets, etc., are included and drawings have been newly prepared and increased in size to present details more clearly.

Prepared by a staff of specialists and edited by John H. Perry, E. I. du Pont de Nemours & Co., the 1884 page, 7¼ × 10 in., cloth bound text is published by McGraw Hill Book Co., Inc., 330 W. 42nd St., New York 18, and is priced at $15.00.

Presents Theory for Determining Friction Loss Coefficients in Heat Exchangers

For most pipe line problems, the pressure losses at abrupt changes in flow cross section are minor relative to the skin friction loss. However, in testing for the flow-friction characteristics of compact heat exchanger surfaces concurrent with heat transfer tests, the entrance and exit losses may become a significant proportion of the total pressure drop. The paper Loss Coefficients for Abrupt Changes in Flow Cross Section with Low Reynolds Number Flow in Single and Multiple Tube Systems presents a theory for evaluating loss coefficients for both single and multiple tube systems for various contraction and expansion geometries. The author, W. M. Kays, acting instructor of mechanical engineering, Stanford University, takes into account the contraction and expansion area ratio and the velocity distribution. Experimental results for the Reynolds number range 500-20,000 are presented. These results are said to be comparable to those of the analysis.

This paper was originally presented at last year's spring meeting of the American Society of Mechanical Engineers. Since then experiments have been performed on single tube systems and these later results are included in the paper which is identified as No. 50-S-7. Copies are available from ASME headquarters 29 W. 39th St., New York 18.

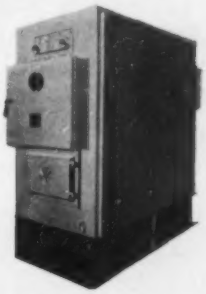
Other Books and Reports Received

Unfired Pressure Vessel Code—The 1949 edition of this code (Section 8 of the Boiler Construction Code) is now off the press and contains all changes and additions of the past three years. Topics covered include safety devices, materials, working pressures, riveted joints, dished heads, flat heads, braced and stayed surfaces, caulking, manholes and handholes, nozzle openings, fusion welding, forge welding, vessels subjected to external pressure, and vessels at sub-zero temperatures. Paper covered copies may be obtained for $2.25 from the American Society of Mechanical Engineers, 29 W. 39th St., New York 18.

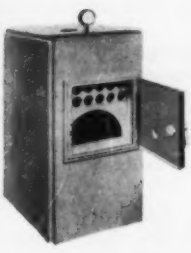
Industrial Ventilation Guide, prepared by the Propeller Fan Manufacturers Association, 2159 Guardian Bldg., Detroit 26—Provides a concise and informative coverage of general industrial ventilation problems and their solutions. Topics covered include types of ventilation, system pressure, recommended air changes, duct resistance, and certified rating tables of ventilation equipment. Copies are available at no charge.

CLIFF Steel BOILERS

FOR THE RESIDENCE • APARTMENT • OR SMALL BUILDING



A complete line from the smallest cottage type residence to the largest public building. Smart dealers are cashing in on the new low cost but high quality steel boilers manufactured by one of the oldest firms in the boiler business since 1857.



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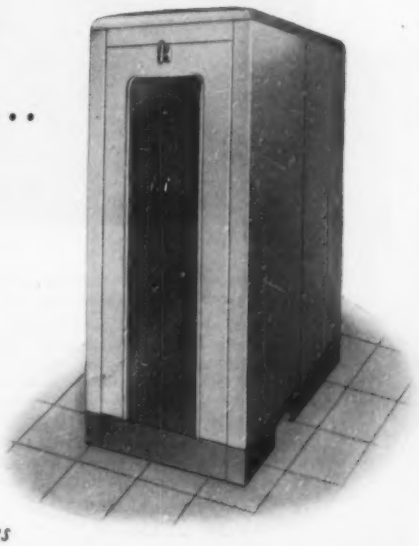

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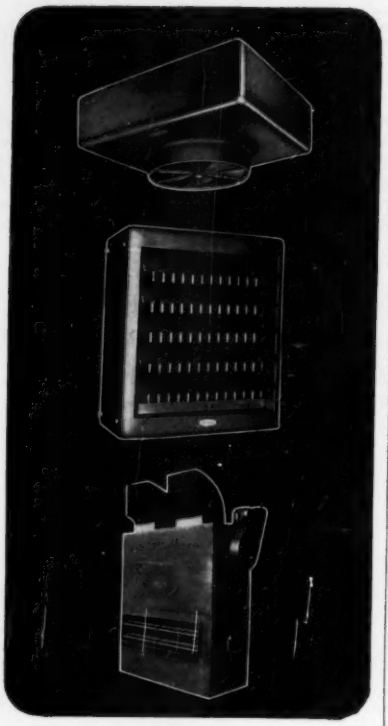

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MEETINGS & CONVENTIONS

I-B-R Heating Short Course, sponsored by the Institute of Boiler and Radiator Manufacturers and the University of Illinois—The fourth short course on steam and hot water heating will be held June 13 to 16, at the University. There will be a program for new students and also one for former students who desire more advanced work.

Requests for information on the course should be addressed to R. K. Newton, supervisor, engineering extension, division of university extension, Room 305, Arcade Bldg., University of Illinois, Urbana, Ill.

Stoker Manufacturers Association, 307 N. Michigan Ave., Chicago 1—The 1950 annual meeting, to be held June 15, La Salle hotel, Chicago.

Industrial Hygiene and Human Relations—A training course designed especially for the benefit of safety personnel to be held June 19 to 21, University of Michigan School of Public Health, Ann Arbor, Mich.

Applications for enrollment should be submitted to H. E. Miller at the School of Public Health. The fee is $5.00.

American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York 10. Semi-annual meeting, Royal Muskoka hotel, on the Muskoka lakes, Ontario, Canada, June 19 to 21. For details, see the ASHVE Journal Section in this issue.

The 1951 annual meeting will be held in Philadelphia, January 22 to 25. Registration and technical sessions will be at the Bellevue-Stratford hotel, other meeting functions at the Benjamin Franklin and Warwick hotels.

American Society of Mechanical Engineers, 29 W. 39th St., New York City—The semi-annual meeting will be held June 19 to 23, Hotel Statler, St. Louis. The fall meeting is scheduled for September 19 to 21, Hotel Sheraton, Worcester, Mass., and the annual meeting will be held November 26 to December 1, Hotel Statler, New York City.

American Society for Testing Materials, 1916 Race St., Philadelphia 3—The 1950 annual meeting and 9th Exhibit of Testing Apparatus and Equipment, June 26 to 30, Chalfonte-Haddon Hall, Atlantic City. Some 23 technical sessions and 400 committee meetings are planned. Some of the round table discussions and technical sessions will deal with the effect of sigma phase in the high temperature properties of metals, the properties of ferrous and nonferrous metals at elevated temperatures, and corrosion of metals.

The 1951 annual meeting is scheduled for June 18 to 21, Atlantic City, and the 1952 annual meeting will be held June 22 to 27, New York City.

First United States International Trade Fair—To be held August 7 to 20, Chicago. Exhibits will be classified under 29 categories, including both industrial and consumer commodities, and will include displays of heating,

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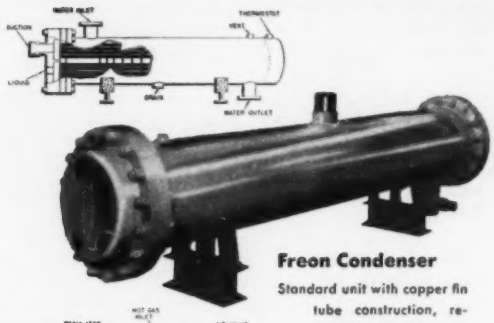

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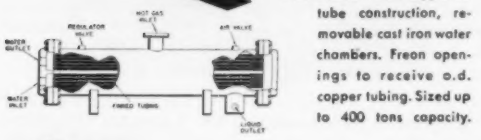
Standard unit with copper fin tube construction, removable cast iron water chambers. Freon openings to receive o.d. copper tubing. Sized up to 400 tons capacity.



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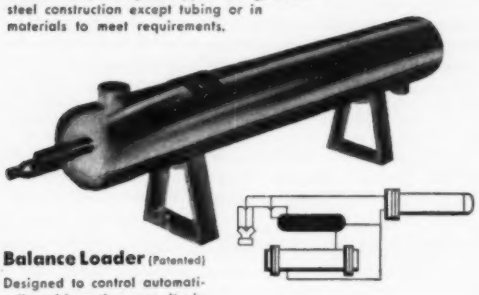
Billet type carbon steel freon chamber with adapters for o.d. copper tubing; removable tube bundle; U-shaped copper tubing; carbon steel construction except tubing or in materials to meet requirements.



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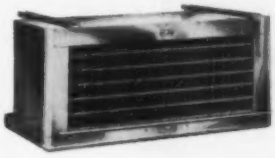

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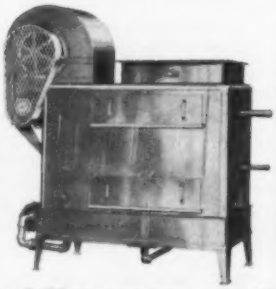

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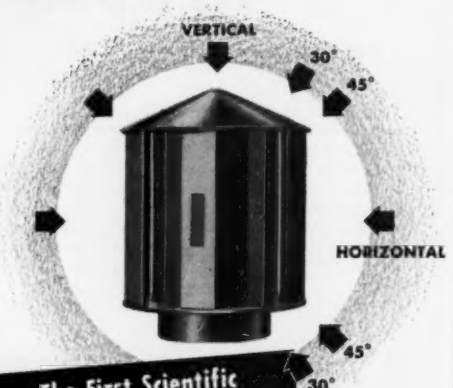
If you want to *be sure* of what you're getting when you buy ventilators, insist on *certified* capacity ratings based on tests made with wind blowing in *all* directions, as indicated below.



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ventilating, and air conditioning equipment. Fair headquarters is in the Merchandise Mart, Chicago 54.

National Power Show, sponsored by the National Association of Power Engineers, 176 W. Adams St., Chicago—The 49th annual show and the 67th annual convention of the association will be held August 15 through 19, Hotel Jefferson, St. Louis.

Sixth National Chemical Exposition, sponsored by the Chicago section of the American Chemical Society, 86 E. Randolph St., Chicago 1—To be held September 5 to 9, Chicago Coliseum. The show will be held concurrently with the national meeting of the American Chemical Society.

Instrument Conference and Exhibit—Sponsored by the Instrument Society of America, 921 Ridge Ave., Pittsburgh 12, the 1950 Instrument Conference and Exhibit will be held in the War Memorial Auditorium, Buffalo, N. Y., from September 18 to 22. This will be the fifth national conference and exhibit of the Society.

American Gas Association, 420 Lexington Ave., New York 17—The 1950 annual convention will be held October 2 to 6, Atlantic City. Haddon Hall has been designated as headquarters for the accounting section; the Ritz Carlton hotel will be headquarters for the residential gas section and the industrial and commercial section; and the Dennis hotel will be headquarters for the operating section.

Refrigeration and Air Conditioning Conference and Exhibit, sponsored jointly by the Refrigeration Equipment Manufacturers Association and the Refrigeration Service Engineers Society—The remaining three conferences in a series of four will be held November 17 to 19, Municipal Auditorium, Long Beach, Calif.; January 26 to 28, State Fair Grounds, Dallas; April 6 to 8, Hotel Statler, Buffalo.

Additional information may be obtained from the REMA public relations department, 1346 Connecticut Ave., N.W., Washington 6, D. C.

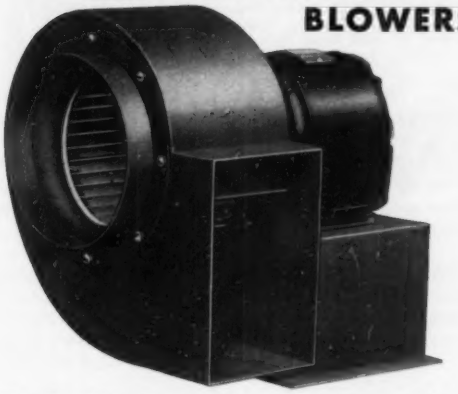
Refrigeration Service Engineers Society, 433 N. Waller Ave., Chicago—The 13th annual meeting, November 17 through 19, Long Beach, Calif.

10th International Heating, Ventilating and Air Conditioning Exposition—Under the auspices of the American Society of Heating and Ventilating Engineers, the show will be held January 22 to 26, Commercial Museum, Philadelphia. International Exposition Co., Grand Central Palace, New York City, is managing the affair.

British Building Research Congress—Sponsored by a number of professional institutions and societies, government departments, and representative industrial federations, the congress will be held in London, September 11 to 20, 1951. Additional information may be obtained from the organizing secretary, Building Research Congress 1951, Building Research Station, Bucknalls Lane, Garston, Watford, Herts, England.

Peerless Electric

DIRECT-DRIVE UTILITY BLOWERS



● Peerless Utility Blowers are known the country over for dependability. They are widely used for general ventilation and exhaust where duct systems are required, and for wash rooms, boiler rooms, restaurants, or wherever circulation through a limited area is indicated. Compact, easy to mount and quiet in operation, these blowers are designed to deliver large volumes of air at extremely economical cost.

HOUSING AND WHEELS—The arc-welded housings are constructed of 16-gauge steel, with sturdy spot-welded motor bases. Wheels are designed for efficient operation and are dynamically balanced. Heavy cast-iron hubs support the rigid riveted wheels.

MOTORS—Available in all types of current characteristics, to suit all requirements. Single-phase motors are wool-packed, sleeve-bearing, resilient-mounted for quiet operation. Three-phase units, either sleeve or ball bearing, are rigid mounted. Units with single-phase motors are shipped from stock as follows:

Size 0—Permanent split-capacitor type, 115 volt
Sizes 1 and 1¼—Split-phase type, 115/230 volt
Sizes 1½, 1¾ and 2—Capacitor-Induction type, 115/230 volt

ROTATION AND DISCHARGE—The units are constructed as standard in clockwise rotation but can also be furnished counter-clockwise when so specified. Housings may be turned in any one of eight different ways at time of installation, for any discharge direction desired.

FINISH—The finish is hard baked gray enamel for durability.

CUSTOM FEATURES—Weather-proof covers, available for outside installation, eliminate the need for penthouse or other protection. Inquiries are invited for other special features that may be desired, such as brass wheels, isolation dampeners, or special designs to fit particular applications. Numerous units are being built today for such special requirements.

CAPACITIES—These blowers are tested and rated in accordance with test codes adopted by the National Association of Fan Manufacturers and the American Society of Heating and Ventilating Engineers.

GUARANTEE—Complete units are guaranteed against defective workmanship or material for a period of one year from date of shipment from factory. Every unit shipped is recorded in the name of the purchaser as to all of its features (size, motor, windings, etc.) to benefit you greatly for immediate identification for spare parts, replacement or duplicate requirements. Write for complete specification sheet.

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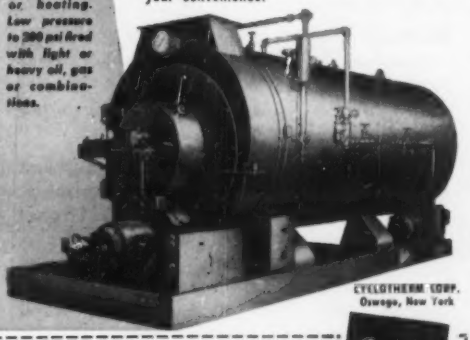

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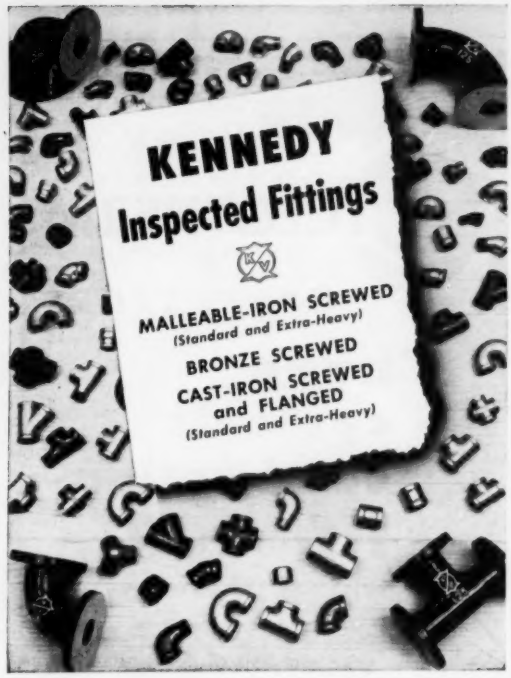

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BRONZE. Durable, long-lived bronze, rough or polished, precision threaded and well chamfered for easy pipe-fitting and thread protection. Individually inspected . . . *each air-tested under water.*

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RECENT TRADE LITERATURE

For your convenience in obtaining copies of these bulletins, see coupon on page 177. If you write direct to the manufacturer, describe carefully what literature you want, as the number given first in each item is for use only when sending requests to Heating, Piping & Air Conditioning.

HPAC 7670—AGE OF A U.S. PATENT—The Patent Reporting Div., Invention, Inc., Munsey Bldg., Washington 4, D. C., has published a small folder entitled Telling the Age of a United States Patent. The publication lists the number of each patent, reissue, design, and trade mark, granted at the beginning of each calendar year from 1836 to date.

HPAC 7671—AIR CONDITIONERS—A 12 page catalog (PM-79-0100) covers the complete line of packaged air conditioners of the air conditioning department, General Electric Co., Bloomfield, N. J. The booklet covers units in 2, 3, 5, 7½ and 10 hp capacities and detailed information on each model is given.

HPAC 7672—AIR DIFFUSERS—Catalog F-4085 of Barber-Colman Co., Rockford, Ill., describes and illustrates the "Venturi-Flo" line of ceiling air distribution outlets. In addition to covering design and construction features, the catalog gives dimensions and includes tabulated performance data.

HPAC 7673—AIR POWERED PUMPS—The controlled volume pumps of Milton Roy Co., 1300 E. Mermaid Lane, Chestnut Hill, Philadelphia 18, are positive displacement metering units with double-ball check liquid ends. They may be used for automatic blending systems, automatic caustic dilution systems, as hydrostatic test pumps, for constant pressure lubrication systems, for automatic proportioning systems, and for sampling industrial waste. A new 16 page bulletin (No. 450) gives detailed information.

HPAC 7674—ASBESTOS INSULATING CEMENT—A two color, 8½ in. × 11 in. circular illustrates how "Non-Con-Dux" asbestos insulating cement is applied to tanks and boilers. Released by Grant Wilson Inc., 141 W. Jackson Blvd., Chicago 4, the circular (No. 1540) calls attention to the fuel saving possibilities of the cement.

HPAC 7675—AUTOMATIC CLUTCHES—Automatic Steel Products, Inc., Canton, Ohio. The complete line of "Mercury" automatic clutches is described and illustrated in three new bulletins. Bulletin 216, 8 pages, describes the clutch in general, listing and illustrating various applications including air conditioning. Bulletin 217, 4 pages, deals with clutches applied to gasoline engines, and Bulletin 218, 4 pages, covers electric motor installations.

HPAC 7676—BASEBOARD HEATING UNIT—A 33 page bulletin of United States Radiator Corp., Detroit 31, leads off with a discussion of fundamentals of maintaining human comfort. Advantages of the company's radiant baseboard unit are described, and design and construction features are covered. A series of photographs are used to show how the unit is fabricated and another series shows installation details.

9 out of 10 New Homes Heat with OIL or GAS

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Expand your market to 90% of new home construction with Aldrich. Sell more, with less inventory . . . cash in with oil units, cash in again with gas burners.

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Simplify **fastening insulation to metal ductwork with LEXSUCO INSULATION CLIPS**

SIMPLE — Just insert the clip in the insulation and with the sharp blow of a hammer, it locks itself to the metal duct. The shoulder prevents penetration beyond insulation thickness.

SPEEDY — This easy "hammer and nail" method provides very fast application.

LABOR-SAVING — No preparation of the surface; no special tools or completing materials needed.

SIZES — Available for 1/2", 13/16" and 1" thick insulation.

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HPAC 7677—CAST IRON, TOTALLY ENCLOSED MOTORS—A recent issue of the house organ published by Wagner Electric Corp., 6400 Plymouth Ave., St. Louis 14, features construction details of its cast iron frame, totally enclosed fan cooled motors, which are available in ratings from 5 through 250 hp. Motors are said to be especially suitable for applications in chemical plants, oil fields, refineries, and industrial plants.

HPAC 7678—CENTRIFUGAL PUMPS—Units of the cradle mounted type are covered in a new four page bulletin issued by Ingersoll-Rand Co., 11 Broadway, New York 4. The bulletin shows a sectional view of the pump and describes features of design and construction. Sizes range from ¾ in. to 5 in. discharge with capacities up to 1600 gpm and heads up to 250 ft. Normal horsepower range is from ¼ to 75.

HPAC 7679—COMPRESSED AIR AND GAS POWER—Now available from the secretary, committee on engineering education, Compressed Air and Gas Institute, 1410 Terminal Tower, Cleveland 13, is a new 18 page booklet containing basic reference data on compressed air and gas power. Prepared as a general nontechnical view of the application of compressed air and gas theory to actual machines and uses, the booklet outlines how air is compressed, describes the machines employed in compressing air and gas, and covers the basic principles of utilization of air power.

HPAC 7680—CONCRETE INSERT—Bulletin C1-2 of Unistrut Products Co., 1013 W. Washington St., Chicago 7, enumerates advantages of the company's new concrete inserts. It is pointed out the device permits attachment of fittings at any point along the entire insert face without disturbing attachments previously made. The bulletin also describes a method of making your own inserts from short pieces of "Unistrut" channel and anchor type, drive-in end caps.

HPAC 7681—CONDENSED COOLING, HEATING LOAD ESTIMATE SHEET—A new cooling and heating load estimate sheet is available from The Trane Co., La Crosse, Wis. The new sheets are printed on 8½ × 11 in. transparent paper to conserve file space and to permit blueprint and black line reproduction. They are also punched for ring binding. The new sheet contains spaces for more items than those contained in the previous larger sheets, and included for the first time is space for heating calculations. Pads of 50 are priced at 50 cents per pad; in lots of 12 pads or more at 35 cents per pad. Pads of 25 are priced at 30 cents per pad; in lots of 12 pads or more, 20 cents per pad. Inquiries for the sheet, form 389-A, should be addressed to the company's educational department.

HPAC 7682—COOLING TOWERS—The 10th in a series of quiz sheets dealing with cooling tower performance has been issued by Marley Co. Inc., Fairfax & Marley Rds., Kansas City 15, Kan. Some of the 10 questions, which are answered, deal with the necessary hot water distribution systems required in a cooling tower serving two intermittently operating air conditioning units, the use of a cooling tower to aerate and degasify water, the

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GAS COMBUSTION CONTROL

- Operates the BOILER UPTAKE DAMPER
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IF REPLACEMENT of venting equipment is running up your plant maintenance costs, Transite* Industrial Vent Pipe may help you save money.

In numerous installations, this Johns-Manville asbestos-cement product has demonstrated its ability to give long-term, economical service. Rustproof, it successfully resists many of the corrosive fumes, dusts, vapors and gases encountered in industrial venting operations. It requires no painting or other protective treatment—can be used for vents, ducts or stacks, in either indoor or outdoor service.

Transite Industrial Vent Pipe is available in a wide range of sizes (up to 36" diameter) with a complete line of Transite fittings that adapt it to practically any job requirement. It is light in weight and readily handled—can be cut and drilled on the job with ordinary tools. For additional information, write for Data Sheet, Series DS-336. Address Johns-Manville, Box 290, New York, N. Y.

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Aircraft	Foundry	Pulp & Paper
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Boiler Works	Glass	Refrigeration
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Canning	Laundry	Shipbuilding
Ceramic	Leather	Shoe
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Dairy	Meat Packing	Soap
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1. It has no flange, no collar, no protruding part to cause run-out or wobble.
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earthquake factor in designing a cooling tower, and the advantages and practical size limitations of large fans.

HPAC 7683—DOUBLE SUCTION CENTRIFUGAL PUMPS—Worthington Pump & Machinery Corp., Harrison, N. J., has issued bulletin W-318-B21 on its two stage, double suction, centrifugal pumps, type UZD. Tabulated dimensions, a selection chart, and drawings are included.

HPAC 7684—DUST COLLECTORS—Ducon Co., Mineola, N. Y. Catalog DC 49-2 describes constructional and operating features of "Duclone" collectors. Efficiency curves, schematic drawings of different industrial applications, and other pertinent illustrations are included.

HPAC 7685—ELECTRIC ARC WELDING—Hobart Trade School, Troy, Ohio, has issued a 544 page textbook on the procedure and practice of arc welding. The 28 chapters are divided into five parts dealing with general information, operator training course, carbon arc welding and cutting, other welding processes, and welding terms and their definitions. Copies of the book may be obtained from the school for $3.00.

HPAC 7686—ELECTRIC WELD PIPE—A new 20 page booklet (ADV-521) on pipe made by the electric resistance weld method has been released by Republic Steel Corp., 3100 E. 45th St., Cleveland 27. The catalog contains a description of the manufacturing process, shows the sequence of operations in chart form, and covers 10 specific advantages. Technical data are tabulated.

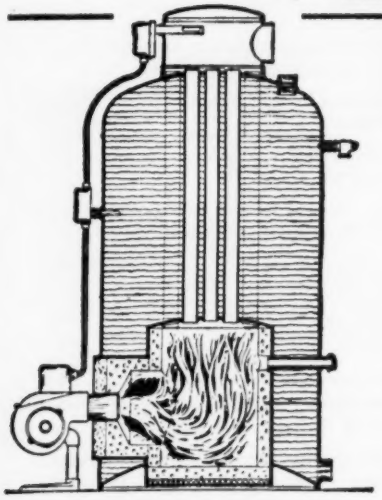
HPAC 7687—FAN STANDARDS—Bulletin 110 of the National Association of Fan Manufacturers, Inc., 2159 Guardian Bldg., Detroit 26, contains standards, definitions, terms and test codes for centrifugal, axial and propeller fans. The bulletin includes under one cover all the information previously published in four separate bulletins, as well as new tables on size standards for various types of fans and illustrations of revised fan arrangements.

HPAC 7688—FANS AND BLOWERS—Chelsea Fan & Blower Co., Inc., 1206 Grove St., Irvington 11, N. J. A new illustrated catalog gives engineering information, dimensions, and performance data on various types and sizes of both propeller and centrifugal type fans. Included is information on direct drive or belt driven window units, industrial pressure fans, man coolers, penthouse fans, duct booster fans, etc.

HPAC 7689—FANS, V-PULLEYS AND BELTS—"Mor-Aire" propeller type fans, recommended for use in connection with air cooling refrigerant condensers, are covered in Bulletin R-F 301-5003 of Maurey Mfg. Corp., 2907-2921 S. Wabash Ave., Chicago 16. Also described and illustrated are three bladed, propeller type fan units for general ventilation use. Data on the company's fan v pulleys and v belts are also given.

HPAC 7690—FASTENERS—The first volume of case histories describing the cost reductions provided by "Speed Nut" products of Tinnerman Products, Inc., Cleveland 13, is now off the press. The booklet contains

THERE'S AN AQULUX MODEL AND SIZE FOR EVERY HOT WATER NEED!



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Engineering data and reprint of WATER COOLED ROOFS article which appeared in the Architectural Forum mailed anywhere upon request.

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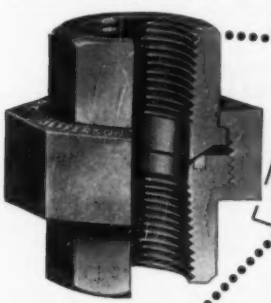

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Close fits are simple with Jefferson Unions . . . and once in they'll STAY in because we make them from a very fine malleable iron with a tensile strength of 55,000 lbs per sq in. Details such as the machining instead of casting the ring channels . . . making the rings from special tubing instead of casting them and testing all fittings with air before delivery all add up to a minimum of maintenance after the installation. You're sure the job's in to stay when the joints are made with Jefferson Specialty Unions.

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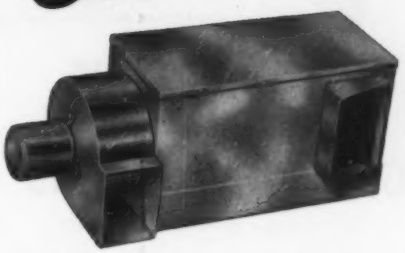

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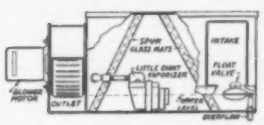
When this unit is used in conjunction with any standard 110 volt humidistat, humidity can be controlled with the same degree of accuracy as temperature control.

The Little Giant Vaporizer Package Unit is for use in either home or industrial heating plants. It is easy to install in new furnaces or in ones already in use. Operation of this unit will not rust furnace or ducts. The Little Giant Vaporizer contained in this unit is guaranteed for two years.



Cutaway drawing of the Little Giant Vaporizer Package Unit.

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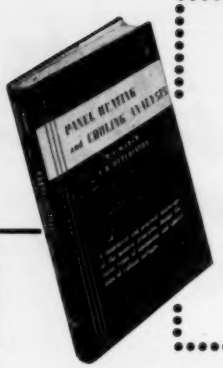

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14 reprints of advertisements reporting how various firms have effected savings in assembly costs through the use of the company's nuts, clips, and clamps.

HPAC 7691—FLEXIBLE TUBING—A newly improved type of lightweight, flexible tubing is offered by Flexible Tubing Corp., Branford, Conn. Available in a variety of standard plies and materials, "Spiratube" tubing is designed for most ducting requirements from 3 to 30 in. ID for air and other gases and for powdered, granular, or other light solids. Catalog No. 5-4 gives detailed information.

HPAC 7692—FLOAT AND LEVER VALVES—Klipfel Valves, Inc., Div. of Hamilton-Thomas Corp., Hamilton, Ohio, has prepared a new float and lever valve selection chart. By reference to the service for which the valve is intended, the maximum pressure drop between inlet and outlet, maximum temperature, and other factors, selection of the recommended company valve can be made quickly.

HPAC 7693—FLOW METERS—Fischer & Porter Co., Hatboro, Pa. Catalog 37 illustrates and describes the new mercury manometer flow meters which utilize a magnetic clutch or an impedance bridge electric transmitter. Furnished with 35, 50, 100, 200, and 400 in. water column equivalent range tubes.

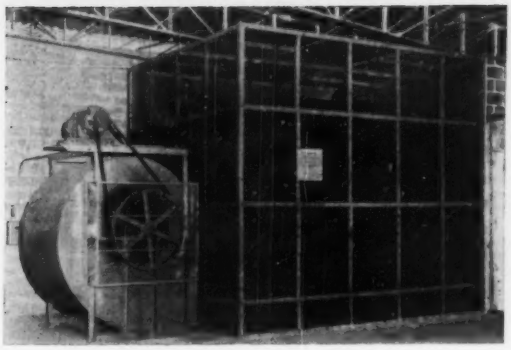
HPAC 7694—GAS FIRED UNIT HEATERS—"Pittsburgh" gas fired unit heaters, series C, featuring cast iron heat exchangers, are illustrated and described in a revised folder issued by Automatic Gas Equipment Co., 301 Brushton Ave., Pittsburgh 21. Specifications for six sizes, ranging from 85,000 to 215,000 Btu per hr, are included.

HPAC 7695—HEAT TRANSFER UNITS—Drayer-Hanson, Inc., Box 2215, Terminal Annex, Los Angeles 33, has issued a 36 page catalog containing information on its extended surface units for air conditioning. Embracing water, steam and direct expansion coils, the new units feature aluminum fins with new and improved casings and staggered tubes. They are being produced in six standard header sizes and in six coil types.

HPAC 7696—HEATING, AIR CONDITIONING EQUIPMENT—Case histories dealing with the use of convectors and unit ventilators in a hospital, the "Custom-Air" system for conditioning a remodeled office building, and unit heaters in a manufacturing plant are featured in the volume 13, No. 12 issue of the house organ published by The Trane Co., La Crosse, Wis. Also in this issue is reprinted an article on the heat pump by Prof. F. W. Hutchinson, of the University of California.

HPAC 7697—HEATING EQUIPMENT—The Vol. 13, No. 6 issue of the house organ published by Modine Mfg. Co., Racine, Wis., features a story on the application of the company's convector-radiation in a new grammar school. Also discussed is the use of cabinet unit heaters and convector-radiation in two new churches.

HPAC 7698—HIGH PRESSURE BLOWERS—Publication 88 of Standard Stoker Co., Inc., 370 Lexington Ave.,



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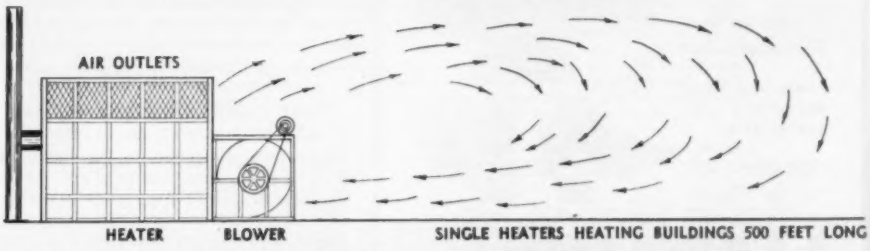
Heaters

THE JOHNSON SYSTEM (patent applied for) OF "AIR-ROTATION" provides 500,000 to 5,000,000 Btu in single units. It will circulate warm air by air rotation to all parts of an open building quickly, evenly, and economically without ducts.

The Johnson system keeps the warm air at the working level and also keeps floors warm and dry.

Fully automatic—uses light or heavy oil, coal stokers, or gas. ***Lower installations and operating costs.***



SINGLE HEATERS HEATING BUILDINGS 500 FEET LONG

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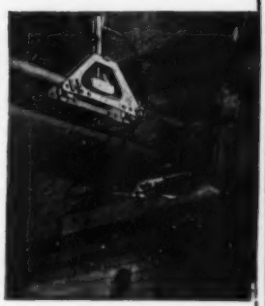
Look how HYDRAULIC Power BENDS PIPE!

- **Save costly fittings, reduce cutting and threading time on radiant heating jobs and other pipe installations.**
- **Bend popular pipe sizes —1" to 4" dia., smoothly, quickly.**
- **Also—use the hydraulic unit as a handy jack.**



New! **Write for Bulletin 50-B . . . get complete facts on Blackhawk's big line of PORTABLE Benders.**

This equipment pays for itself on the first good job. See your supply house or write Blackhawk for Bulletin 50-B today. Blackhawk Mfg. Co., Department P-4660, Milwaukee 1, Wisconsin.

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AUTOMATIC

CEILING SHUTTER

FOR ATTIC FAN

Built so they can be installed practically flush with the ceiling, AIR-FLO Ceiling Shutters present a refined, finished appearance. Their natural aluminum color blends with any decoration, eliminating need for painting, and no grille or winter cover is required. Furnished in 3 different widths, single panel up to 72" long. No operating mechanism shown. Built-in fusible link. Meets fire underwriters requirements.

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Illustrations and details of the complete AIR-FLO line.

AIR CONDITIONING PRODUCTS CO.

2340 W. LAFAYETTE BLVD. · DETROIT 16, MICH.

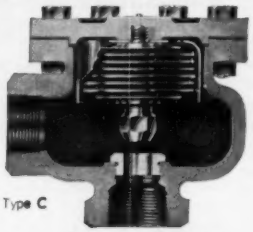
Nicholson Steam Traps Feature

MAXIMUM AIR VENTING

for Faster Steam Transfer

Substantial evidence of the venting effectiveness of Nicholson steam traps is their wide recommendation for eliminating non-condensible gases, as well as condensate, in such equipment as jacketed kettles. Other Nicholson features: operate on lowest temperature differential; 2 to 6 times average drainage capacity.

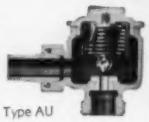
5 Types for Every Plant Application



Type C

Process, heat, power. Size ¼" to 2"; pressures to 225 lbs.

BULLETIN 450 or see Sweet's



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801 Allen Avenue, Glendale 1, California

Manufacturers of Automatic Pressure, Temperature, Level and Flow Controls

New York 17, gives dimensions, ratings, and other pertinent data on the firms' "Standardaire" blowers.

HPAC 7699 — INSULATION — "Rubatex" insulation hardboard is an expanded, synthetic rubber compound. Its cellular structure consists of minute, individually sealed chambers, each containing inert nitrogen. Rubatex Div., Great American Industries, Inc., Bedford, Va., has issued a design data book, RBH-1-50, giving data on thermal and physical properties. Solutions of typical application problems are worked out.

HPAC 7700—LIQUID LEVEL MEASUREMENT—For measuring liquid level changes greater than 5 in., Fischer & Porter Co., Hatboro, Pa., is offering the displaced-buoy "Levelimeter" instrument. By suitably selecting dimensions and properties of the displacer-buoy components, the total liquid-level change is caused to produce a total buoy travel of 5 in., thus matching the standard travel of the firm's instrument transmitters. Detailed information is given in Catalog 75, Supplement No. 1.

HPAC 7701—MAINTENANCE OF ELECTRICAL MACHINES—Allis-Chalmers Mfg. Co., 1171 S. 70th St., Milwaukee. Available in the form of a booklet (No. 05R7417) is a series of articles by Fraser Jeffrey, assistant to the chief electrical engineer, on the care of a-c rotating equipment. The 24 page booklet is divided into preventive maintenance and machine repair. Under the former, subjects such as drying moist insulation, measuring insulation resistance, bearing clearances, and proper machine applications are covered. Machine repair includes data on stator coil and slip ring rotor repairs and balancing of rotating equipment.

HPAC 7702—MODULATING TEMPERATURE CONTROLS—Supplementary Bulletin ST-501, released by Sarcotherm Controls, Inc., Empire State Bldg., New York 1, deals with recent improvements in the company's modulating outdoor controls. A revised chart for enlarged capacity, double seated valves is included.

HPAC 7703—OIL FIRED BOILER—Catalog No. 572, available from National Radiator Co., Johnstown, Pa., describes the "National Packet," a new automatic, oil fired hot water heating boiler. The unit is designed for installation in stores, individual apartment units, roadside diners, motels, and similar locations having a small-to-medium heating load.

HPAC 7704—PACKAGED AIR CONDITIONERS—Bulletin 522-A of Frick Co., Inc., Waynesboro, Pa., briefly covers the company's line of unit air conditioners. Design and construction features, installation, method of operation, and controls are some of the topics covered.

HPAC 7705—PHOSPHATE COATING CHEMICALS—The line of phosphate coating chemicals of American Chemical Paint Co., Ambler, Pa., is briefly covered in the form of a new selection chart which presents tabulated information on metal surfaces treated, type of coating, method of application, typical products treated, chemicals required, etc. The various coatings are used for paint bonding, improving corrosion resistance, rust prevention, and improving wear resistance.

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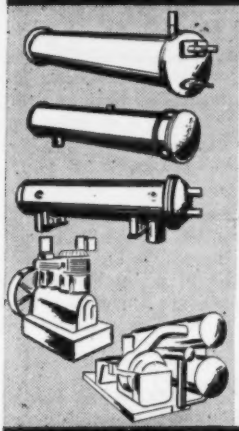
RETUBING SERVICE



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CONDENSERS AND
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ANYTHING WITH TUBES

Reconditioning and
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For New Equipment - Write our general office
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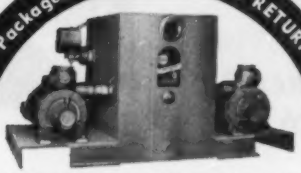
They DEMANDED — "an equally superb, but smaller, unit."

FOR THE SMALLER JOBS

We AGREED — and HERE IT IS!

APCO Packaged CONDENSATION RETURN UNIT



Packaged Duplex Condensation Return Unit Equipped with No. 4 Series Apco Pump.

Sizes up to 15,000 rated sq. ft. equivalent direct radiation

Ideally suited for the automatic return to low pressure boilers of hot water condensation from radiators, coils, etc.,—and for return of water and other liquids to the overhead tanks of gravity circulating systems in industry. Being UTTERLY SIMPLE —HIGHLY EFFICIENT—REMARKABLY TROUBLE-FREE and LASTING, APCO PUMPS establish new high standards of performance.

For larger capacities, write for BULLETIN 113

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A complete line, notable for streamline coordination between Impellers and shells, including Single and Two Stage Horizontally Split Case, Side Suction, Vertical, Non Clog, Sump, Mixed Flow, Special Design, etc.

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cold pipe, conduit and heavy wall tube
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RADIANT HEAT BENDS
In Standard Pipe

Fast . . . Accurate . . . Average bend takes only 60 seconds! Up to 180° bends . . . all sizes from ½" to 2". Usual radiant heat bends for 1¼" at 6" and 9" radii can be supplied. Only 7 parts. Occupies 18" x 18" floor space.

Motor-Powered "American" 2PB

Capacity ½" to 2" standard pipe . . . Minimum radius 5 times pipe diameter up to 180° . . . Maximum radius 13". Complete with rolls for each size pipe. Standard motor equipment 2 h.p.

Special radii supplied on request.

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ATOMIZING SPRAY NOZZLES, SPRAY POND NOZZLES, AND CONDENSER WATER DISTRIBUTORS
For Vertical Shell and Tube Ammonia Condensers

ALL MARTOCELLO SPRAY NOZZLES are manufactured with precision and of a design which has been thoroughly tested for maximum results and durability. They are guaranteed to give satisfaction. Successful, efficient results depend largely upon selecting the proper number, type and size of Nozzles suitable for your installation.

THE MARTOCELLO CONDENSER WATER DISTRIBUTORS are now used as standard equipment by Progressive Refrigerating Engineers in solving their manpower problem, because they require no attention and assure users of the lowest Condenser Operating Pressures and Minimum Power Cost. It will pay you to consult us. WRITE or WIRE for further information.

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A COMPLETE LINE OF AUTOMATIC CONTROLLING AND RECORDING INSTRUMENTS FOR AIR CONDITIONING

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Please send Bulletin on Portable Humidity and Temperature Recorder.

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HPAC 7706—PIPE FITTINGS—Union Malleable Mfg. Co., Ashland, Ohio, has prepared a folder on its malleable iron pipe fittings and cast brass, solder joint fittings. A page of the folder is devoted to the company's "U-Cote" for improving the corrosion resistance of black malleable iron fittings.

HPAC 7707—POCKET SIZE VOLT-AMMETER—The new model A-5-1 "Amprobe" is covered in Catalog No. 109D issued by Pyramid Instrument Co., 49 Howard St., New York 13. Having seven ranges, it is designed specifically for maintenance men, engineers, electricians, and for use in motor repair and service shops.

HPAC 7708—PROPELLER FANS—Schwitzer-Cummins Co., Ventilating Div., 1145 E. 22nd St., Indianapolis 7. Two new leaflets cover "Fresh-Air Maker" propeller type fans. Two sizes of adjustable window fans, 16 and 20 in., and a cabinet type combination window and floor fan with a 24 in. blade are described and illustrated.

HPAC 7709—RECORDING THERMOMETER—Bulletin No. T843 of Bristol Co., Waterbury 20, Conn., covers the Series 500 pipeline recording thermometer for natural and manufactured gas. Methods of application are shown, and a typical chart record is included.

HPAC 7710—REFRIGERATION FITTINGS—Catalog No. R-501 of Madden Brass Products Co., 1111 N. Franklin St., Chicago 10, contains illustrations, detailed information, and prices on the company's line of fittings, driers, strainers, charging lines, liquid indicators, check valves, and accessory items. Complete ordering information is included.

HPAC 7711—REFRIGERATION SPECIALTIES—Catalog No. 99-A of Henry Valve Co., 3215 North Ave., Melrose Park, Ill., covers packless and packed valves, relief and check valves, strainers and dryers, and liquid level gages for refrigeration and air conditioning applications. Catalog 70 describes and illustrates drop forged and cold rolled steel pipe fittings and replaces catalog 69. A list of company wholesalers, most of whom carry substantial stocks of products, is contained in a separate folder.

HPAC 7712—REGULATING VALVES—Swartwout Co., 18511 Euclid Ave., Cleveland 12. Bulletin S-22-C covers low pressure regulating valves for controlling gases and liquids in level, temperature, or pressure requirements. Specifications and selection data are given on regulating valves, valve accessories, and pressure master controls.

HPAC 7713—SEAMLESS CARBON STEEL PRESSURE PIPING—Babcock & Wilcox Tube Co., Beaver Falls, Pa., has issued master price sheets, identified as price schedule A, giving the base prices per 100 ft of average and minimum wall, hot finished and cold drawn seamless carbon steel pressure tubing. The schedule covers cut length tubing produced from open hearth steel having an average carbon content within 0.10 to 0.25 percent.

NEW...

DUAL SWITCH THERMOSTAT

MODEL NWDH for

Controlling Air Conditioning Systems!

The Type NWDH dual switch thermostat with remote bulb for duct mounting is being used in applications in which it is desired to handle two electrical circuits from a single thermal assembly. Typical installations include the control of two compressors, one for normal operation and one for peak loads; or a fan and a compressor.

Standard switches are rated at 15 amps 125/250 V. AC. Switches rated at ¾ hp 125 V. AC, 1½ hp 250 V. AC are also available.

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Whatever your control problem may be, United Electric Controls Co. is prepared to assist you. Send full details and drawings. Write for bulletin giving complete details on the control mentioned above.

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FLOORED by FLOORLEVEL

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Better send at once for our SNOW MELTING MANUAL. It's based on experience with over 100 snow melting systems for

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and other applications which HAVE proved that this modern method of snow removal

Costs No More Than Other Methods

—and because snow melting by pipe coils has other distinct advantages, such as dirt-free sidewalks and entrances, and the complete elimination of ice surfaces, the demand for this method of snow removal is swiftly growing.

Complete information on the correct design, installation and operation of snow melting systems of all kinds is now offered to you in the new SNOW MELTING MANUAL published by HEATING, PIPING & AIR CONDITIONING.

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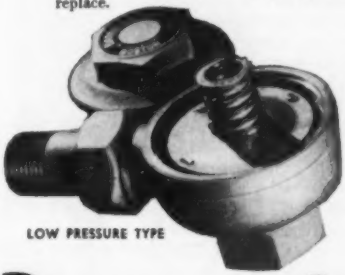
THERMOSTATIC RADIATOR TRAPS

Writing heating specs?

Original installation of Barnes & Jones traps cures the maintenance man's headache before it begins. Only the element and seat can ever wear out and these, because of the unique construction, are simplicity itself to replace.



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Barnes & Jones

Barnes & Jones makes replacement of a worn out element as easy as 1, 2, 3 *and that's minutes!* Write for Catalog 76.

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Users actually bubble over with enthusiasm for the performance of DRIVE-IT powder-actuated fastening tools. One of them started a letter to us the same way we headlined this ad . . . "Hurrah and congratulations for selling us your DRIVE-IT tool!" And that letter is no exception. Hundreds of contractors, builders, and sheet metal men praise the efficiency of DRIVE-IT for fast, *safer* fastening of steel or wood to concrete or steel.
Get the *facts* on the new DRIVE-IT "300" and you, too, will say "hurrah"!

DRIVE-IT "300"

Check these exclusive features of the *DRIVE-IT "300"*

- ☑ Controlled power with one power charge
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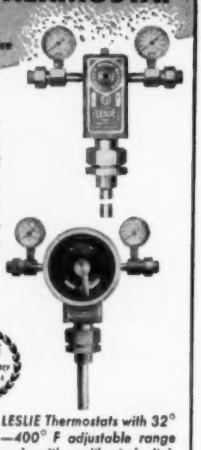
Reduce Water Bills and Maintenance Costs with the New LESLIE THERMOSTAT

Specially designed for cooling water service with greatly increased throttling range



It is a recognized fact that water cooled equipment, performs better and requires less maintenance if cooling water temperature is accurately maintained. New LESLIE Thermostat and Diaphragm Regulating Valve make an ideal Temperature Controller for this service.

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THROTTLING RANGE
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SIMPLE
RUGGED, RELIABLE

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LESLIE Thermostats with 32° —400° F adjustable range and with calibrated dial.

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PRESSURE REDUCING VALVES • PRESSURE CONTROLLERS
FLOATLESS LEVEL CONTROLS • PUMP GOVERNORS
TEMPERATURE REGULATORS • SELF CLEANING STRAINERS
AIR HORNS • STEAM WHISTLES

HPAC 7714—SHUTTERS, EXHAUST FANS, PENTHOUSES—Airmaster Corp., 4317 Ravenswood Ave., Chicago 13, has issued three new catalogs. Bulletin 50-1-4 covers direct and belt driven propeller type fans, gravity operated aluminum shutters, motor operated steel shutters, and penthouses. Propeller type air circulating fans are described in Bulletin 50-2-4 and attic ventilating fans are covered in Bulletin 50-3-4.

HPAC 7715—SPRAY NOZZLES—Catalog No. 30 of the Industrial Div., Delavan Mfg. Co., 3009 Sixth Ave., Des Moines, Iowa, covers spray nozzles and accessories for industrial and air conditioning applications. A list of recommended uses is indicated for each type of nozzle. Spray characteristics are described, and construction features are explained.

HPAC 7716—STAINLESS STEEL WELDING FITTINGS—Cooper Alloy Foundry Co., Hillside 5, N. J. Price list 52W covers a variety of fittings such as elbows, return bends, stub ends, tees, etc., in types 304, 316, and 347 stainless steel.

HPAC 7717—STEAM PLANT EQUIPMENT—Bulletin G-1307 of Yarnall-Waring Co., Mermaid Lane, Philadelphia 18, has been revised and covers low pressure, medium pressure and high pressure blowoff valves, water columns and gages, liquid level indicators and recorders, expansion joints, steam traps, strainers and spray nozzles.

HPAC 7718—STEEL WATER LINES—Dresser Mfg. Div., Dresser Industries, Inc., Bradford, Pa., has released its third annual report on water lines. This 8 page report carries construction details on principal steel water lines laid during the past year.

HPAC 7719—TESTING PROPELLER FANS—Bulletin No. 50 of the Propeller Fan Manufacturers' Association, 2159 Guardian Bldg., Detroit 26, is written in nontechnical language and was prepared to enable a buyer to better understand the terms, standards and methods of test in use by the industry.

HPAC 7720—THERMOMETERS—Specifications for 80 different commercial thermometers for a wide variety of temperature measurements are contained in Catalog 16-C51 issued by H-B Instrument Co., 2633 Trenton Ave., Philadelphia 25. Among thermometers described are those for both indoor and outdoor use, refrigerator cars, refrigeration lines, steam and hot oil lines, air ducts, diesel engines, and general testing.

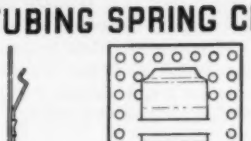
HPAC 7721—TRAPS—W. H. Nicholson & Co., 12 Oregon St., Wilkes-Barre, Pa., has released a 32 p. catalog (No. 250) covering five types of thermostatic steam traps for pressures up to 225 psi, two types of expansion steam traps for pressures up to 250 psi, three types of weight-operated traps for steam, air and gasoline at pressures up to 1500 psi, piston operated steam traps for pressures up to 650 psi, and also three types of steam, air, and gas separators.

HPAC 7722—TURBINE DRIVEN UNIT HEATERS—L. J. Wing Mfg. Co., Linden, N. J. Detailed information on the design and construction of the company's turbine

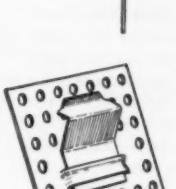
Introducing

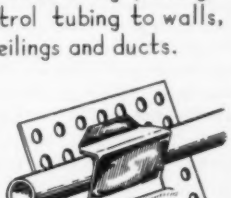
Stic-Klip's newest addition

the "TUBING SPRING CLIP"



for attaching $\frac{1}{4}$" and $\frac{3}{8}$" control tubing to walls, ceilings and ducts.





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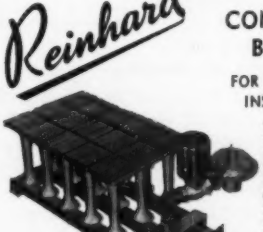

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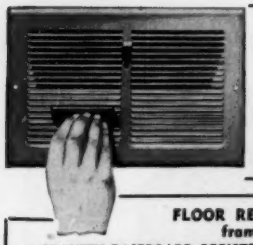

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HPAC 7723—VACUUM PUMPS—Beach-Russ Co., 50 Church St., New York 7, has released the first number of a new house organ. Following a brief and general discussion of vacuum and its place in industry, the folder deals with the control of sludge formation in vacuum pumps and describes a new vacuum pump for air conditioning and refrigeration service work.

HPAC 7724—VALVE SIZING CHARTS—Fischer & Porter Co., Hatboro, Pa. Charts covering the ranges 0.02 to 10,000 gpm and 1 to 100,000 psi are now available. The liquid valve sizing chart takes into account the difference between pressure drop across the valve and across the valve ports alone, liquid viscosity, and specific gravity in determining port area and valve size. The gas valve sizing chart takes into account inlet and outlet absolute pressures, gas specific gravity, and temperature.

HPAC 7725—WATER, BRINE COOLING UNITS—Complete units including the compressor-condenser, controls, and the cooler, are available in sizes from 3 to 30 hp from Refrigeration Economics Co., Canton 2, Ohio. A new data sheet gives detailed information.

HPAC 7726—WELDING FITTINGS AND FLANGES—Grinnell Co., Inc., Providence 1, R. I. A new 88 page catalog (wf-1950) covers seamless carbon steel welding fittings and forged steel flanges. In addition to presenting standard schedules with their specifications, list prices and sizes, the bulletin gives information on dimensional tolerances, American Standard flange spacings with dimensions, thread standards and threading practice, service pressure ratings, physical and chemical requirements for flanges, nuts and bolts, together with sizes and wall thicknesses of welding fittings stocked in other metals, such as stainless steel, inconel, nickel, monel, aluminum, etc.

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Published by McGraw-Hill Book Co., Inc., 330 W. 42nd St., New York 18, and priced at $6.50, the book contains 320 pages, 7½ × 10½ in.

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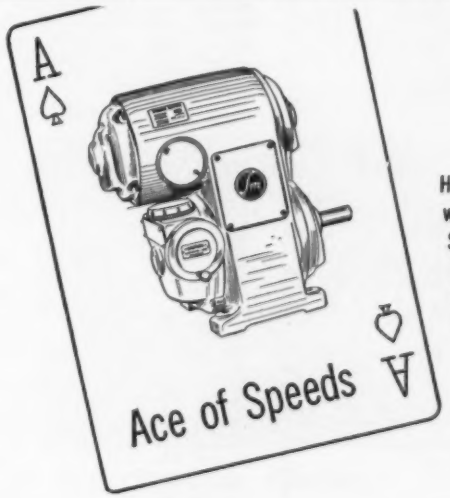
Engineer for Air Conditioners, Freezers, and Household Design with drafting room experience wanted by large established midwestern manufacturer. Submit complete data as to qualifications to Key #860-A, Heating, Piping & Air Conditioning, 6 No. Michigan Ave., Chicago 2.



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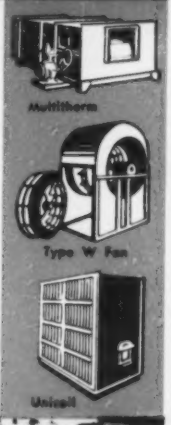
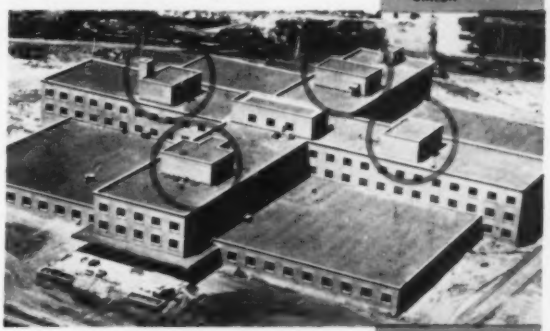
5 MULTITHERMS... 10 FANS... 6 UNICOILS

Built by The Port of New York Authority, this new $5,000,000 Federal Building provides facilities for two United States agencies: The Civil Aeronautics Authority and The Weather Bureau Regional Office. Architects: Reinhard, Hofmeister and Walquist. Engineers (complete mechanical and electrical plans including air conditioning): Guy B. Panero.

All office areas, the lobby, cafeteria and dining room are air conditioned for year around comfort. *Clarage Multitherms, Clarage Fans and Clarage Unicoils are used throughout.* From the standpoint of economy of installation, efficient operation and close control, this air conditioning project represents the ultimate in planning and equipment.

Significant, it would seem, is the fact that Clarage HEAVY-DUTY equipment is so often selected for important jobs such as this one. Yes, if you have any type of requirement in our field, it will pay you to call on us!





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Zone control in conditioning the two upper office floors is accomplished by using four central systems — one system serving each building wing. Other conditioned areas are cared for by three additional systems. For summer cooling, one refrigeration plant furnishes chilled water to all seven systems having a total capacity of approximately 127,500 c.f.m.

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KALAMAZOO, MICHIGAN

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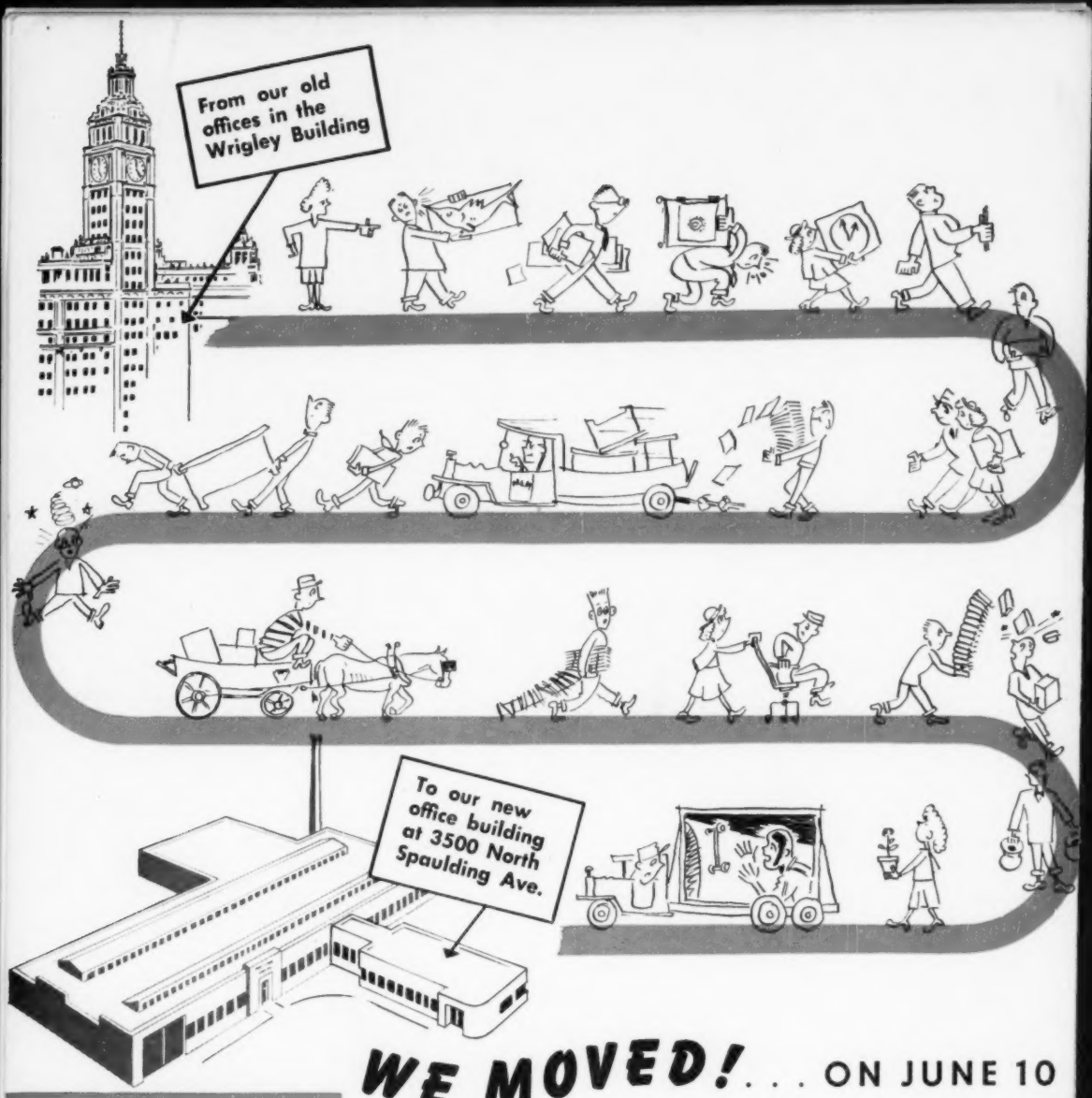

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This, as the home planners say, is our dream house; every detail of it planned and re-planned to fit every requirement of our general office operations.

We have never conceded anything to anyone in the matter of office operation and despatch . . . *but* . . . now we modestly say: "You aint seen nuthin, yet!"

Make us live up to this by sending your next problem (or order) to our

New address of both general offices and plant:

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3500 N. SPAULDING AVE. • CHICAGO 18, ILLINOIS

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